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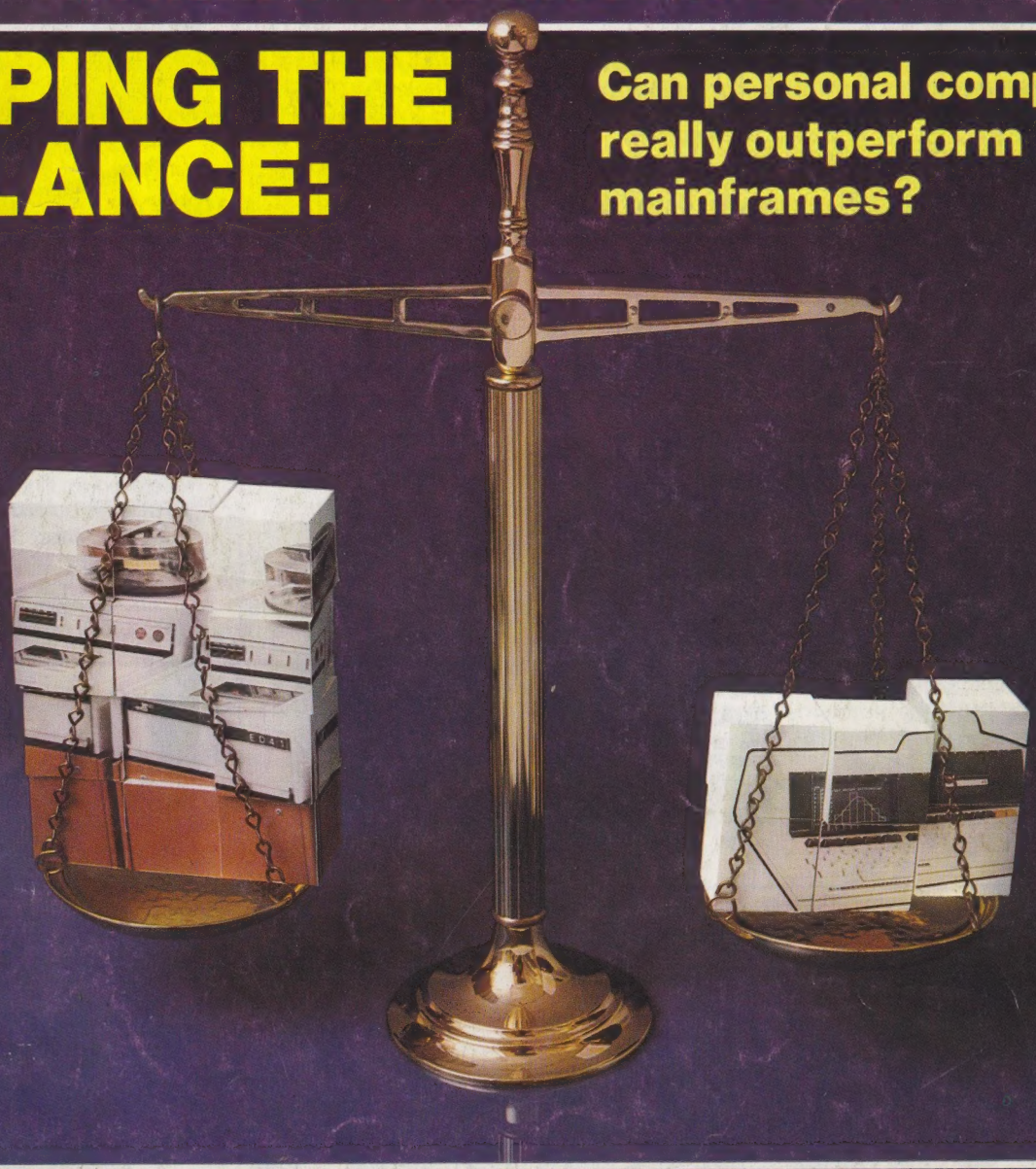

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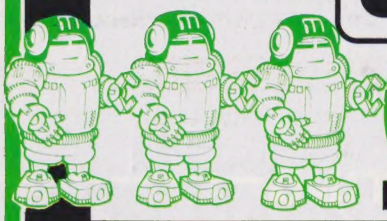

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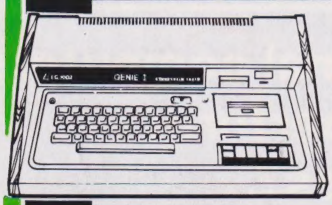

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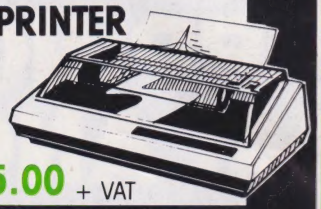

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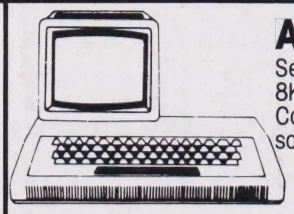

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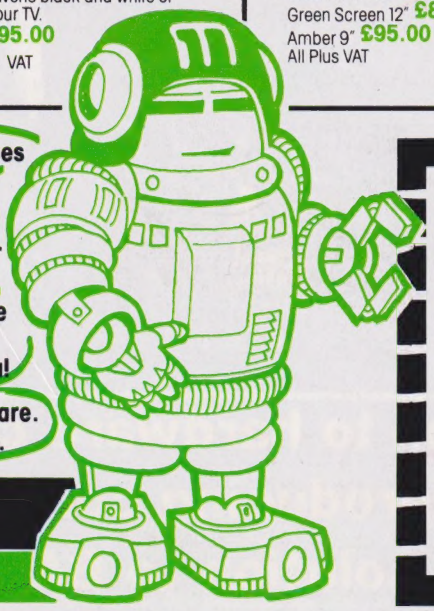

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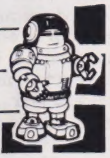

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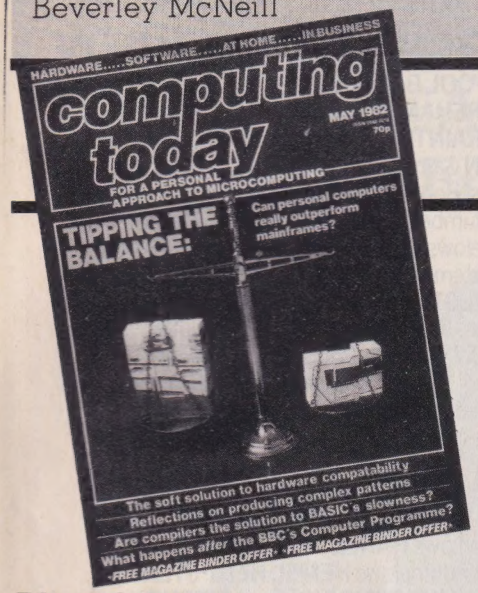

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CONTENTS

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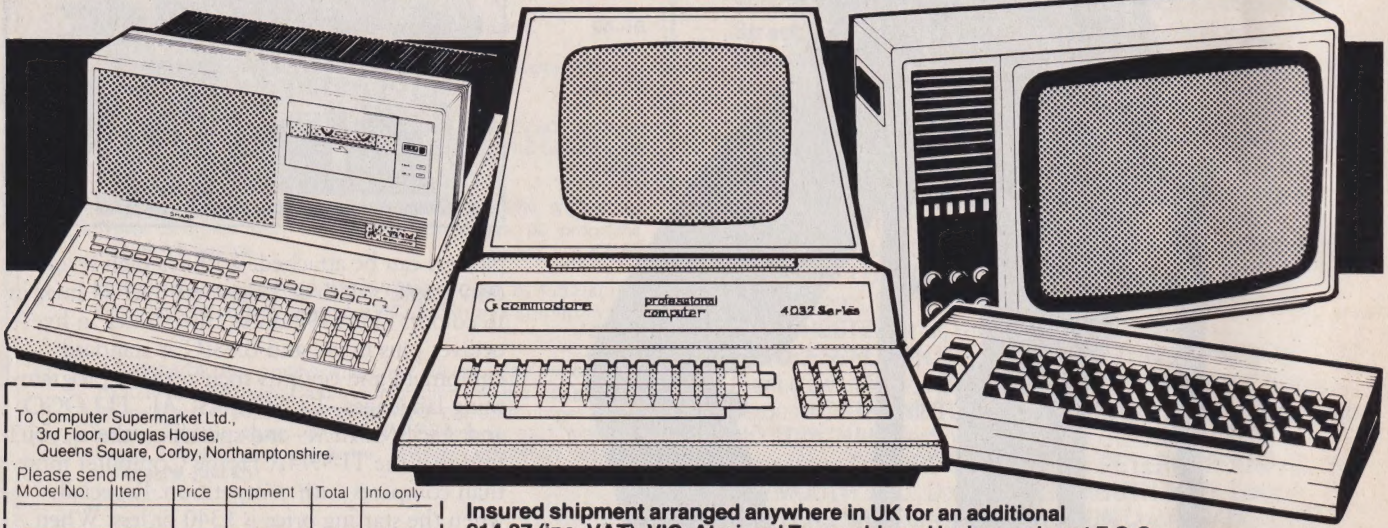

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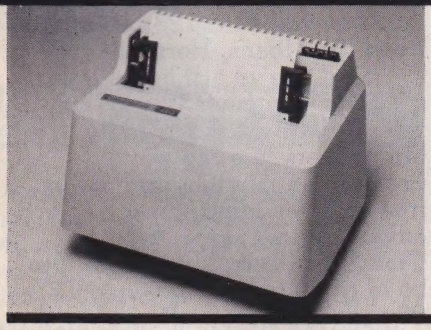

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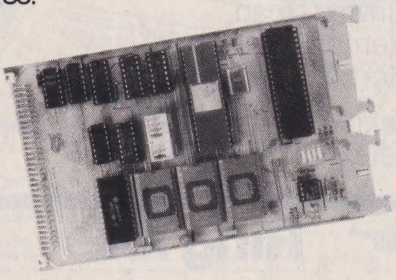
Two interfaces to be offered with the Mark V are the Intelligent Sensorboard, a chessboard that 'reads' pieces without touch sensing; and the Mark V printer that can show game progress and analysis as well as a full chessboard picture in printout form.

The Mark V is priced at £279 with the two interfaces, the Intelligent Sensorboard offered at £155 with the printer still to be announced. For further information make the right move and get in touch with Vulcan Electronics, 200, Brent Street, Hendon, London NW4 or telephone them on 01-203 5161.

SINGLE AND BOARD?

A single Eurocard computer is available from Windrush Micro Designs Ltd for approximately £185.



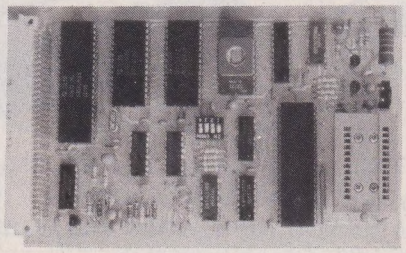
This 100 x 160 mm card will stand alone with I/O and communications or may be expanded to a larger system via its bus connector. The board incorporates either the 6801LI or 6803 CPU, both of which will run standard 6800 machine code.

The board has provision for three EPROM sockets allowing up to 12K of PROM; a CMOS RAM of 2K is also provided on board although this too can be expanded to 128K. A serial port at RS232 levels is provided with three software selectable baud rates: 300, 1200 and 9600.

For more information on the Windrush computer write to Gaymer's Way Industrial Estate, North Walsham, Norfolk NR28 0AN or 'phone on 0692 405189.

ON BOARD FOR BASIC

The Z8-TBDS is a Eurocard BASIC microcomputer offering the facility



of a microcontroller to anyone with access to an RS232 terminal on their system.

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BEEB BUG A LULA

First up, the National Independent User Group for the BBC Micro, BEEBUG, is now running a regular (10 times a year) newsletter devoted exclusively to the BBC Micro. In the April issue there are a couple of new program listings, some hardware and software hints, reviews of the latest software, competitions and discount details.

BEEBUG membership will cost £4.50 for six months and £8.50 for the full year. For more details send a SAE to BEEBUG, 35, St Julians Road, St Albans, Herts.

Next, we've just had a letter from the Computer Users Club who are also catering for BBC Micro users in a big way. Providing a monthly printout of free software ideas, programs and advice on technique, the Computer Users Club would also be of great benefit to Genie/TRS 80 and Compucolor II users wishing to run BBC-based and Prestel software. For further information get in touch with Tony Latham, 72, Sidmouth Road, Welling, Kent DA16 1DS or 'phone him on 01-304 3910.

CONSUMER NEWS

THE PROGRAM STORE

Is the output of your micro too low? Do you experience errors or loss of signal when you play back stored programs?

The ECR81 Enhanced Certified Recorder, designed for use with personal computer systems such as the Sinclair ZX80 and ZX81, have the output level preset before leaving the factory thus eliminating the need to adjust the volume control. The ECR81 is fitted with a long life head matched to TDK's high bias 'Super Avilyn' tapes and also includes a 'write protect' microswitch to protect against accidental tape erasures.

Supplied complete with mains lead, DIN connector and certification tape, the ECR81 is priced at £47.50 including VAT. For further information get in touch with Monolith Electronics Co Ltd, 5-7, Church Street, Crewkerne, Somerset or telephone on 0460-74321.

TIME, GENTLEMEN PLEASE

The K-DOS listing, inspired by the article written by Paul Kriwaczek, is still available from us but, there's a catch. It will now cost you £1.50. Sorry, but you did have your chance. Cheques and Postal Orders must be made out to ASP Ltd.

While we're on the subject of writing to Computing Today, here's a couple of moans. First, we do not deal with technical enquiries on the 'phone but we'll be happy to look into them providing you accompany them with a large stamped addressed envelope (at least 9½" x 5"). Also, if you send in software for consideration please send in a SAE otherwise we cannot return it if we do not use it.

Okay, I'll get off the CT soapbox now . . .but be warned!

THE HITCH-HIKER'S ▶ GUIDE?

Built around the Multiboard system, the Galaxy-1 computer includes twin Z80 microprocessors, 64K of dynamic RAM, two double-density 5¼" floppy disc drives giving 400K of storage per drive and a detachable 59-key keyboard. The second microprocessor controls all the video functions thus freeing the entire RAM for program execution.

The Galaxy-1 system is also supplied with a comprehensive selection of software including the CP/M2.2 disc operating system and COMAL-80 — an extended BASIC. The system also offers a useful text editor and formatter called GEM-PLAN; a Z80 editor/assembler called GEM-ZAP; and a machine code debugging utility called GEM-DEBUG.

Galaxy-1 is available for £1450 + VAT. A full specification and list of stockists can be obtained from Gemini Microcomputers Ltd, Oakfield Corner, Sycamore Road, Amersham, Bucks or by 'phoning 02403 28321.

MICROFAIR '82 ▲

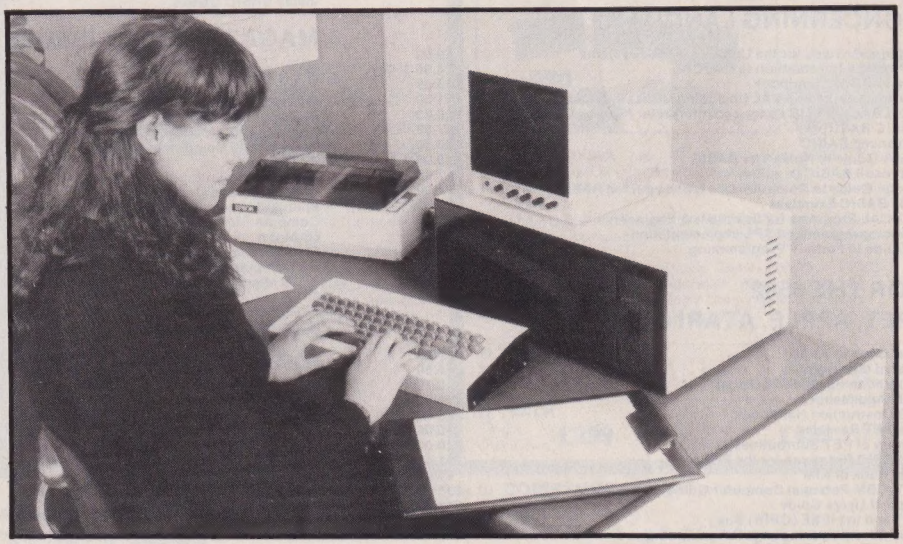
Hardware developments for the ZX81 were the main products on show at the second ZX Microfair held at Westminster Central Hall on January 30th.

Some 12,000 people crammed into the hall during the fair; at one time there was a three hour queue to get in, stretching all the way into St James' Park! However, once inside, the scene was hot and chaotic — punters were crowded six and seven deep around the 40 or so stands trying to get a glimpse of the motherboards and character generators; SPACE INVADERS, DEFENDER and ADVENTURER games by the ton and books by the truckload.

Since the last show, when software and publications ruled the roost, a lot of personhours have gone into producing peripherals for the ZX81 . . . and they show what a remarkably flexible computer it can be. The available add-ons included a music synthesiser and 16 line control port for £19.95 from William Stuart Systems Ltd (0277-810 244); a range of products including facility for a light pen and the new 8100 System from RD Laboratories of Dane End, Ware; and also a keyboard and motherboard from Redditch Electronics (0527 61240).

The next ZX Microfair will be held later on this year on Saturday, 1st May at, yes you've guessed, the same old crowded site.

Tim Hartnell



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FOR THE Z80, TRS-80, ZX81, 380Z

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32 BASIC Programs for the TRS-80 (Level II) 16K	£11.10
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This book is designed to follow on from 'Microprocessors: From Chips to Systems' and so assumes that the user has a prior understanding of microcomputer systems. This comprehensive book introduces the basic interfacing concepts and techniques, and then presents in detail the implementation details from hardware to software. It outlines the techniques and components necessary to assemble a complete system from a basic central processing unit to a system equipped with all the usual peripherals from keyboard to floppy disc as well as the standard buses (S11 to IEEE 488). An invaluable reference book for any person hoping to develop their system at a low cost.

Interfacing to S-100/IEEE 696 microcomputers

This book helps S-100 Bus users expand the utility and power of their systems and describes the S-100 Bus with unmatched precision. Various chapters describe its mechanical and functional design, logical and electrical relationships, bus interconnections, and busing techniques. Both parallel and serial interfacing are described, as well as interfacing to RAM, ROM, and the real world. Additional chapters discuss A/D and D/A conversion, interrupts, timers, and direct memory access. A very useful book.

PET and the IEEE 488 (GPIB) Bus

The instrument designer, scientist, programmer and PET computer hobbyist will all find that this book provides the guidelines for achieving a low-cost, versatile system that may be interfaced to any of hundreds of electronic instruments.
The specific aim of this book is to describe the relationship between the PET and the IEEE 488 Bus in sufficient technical depth for the PET user to be able to find the answers to timing and address problems that might occur while interfacing a variety of electronic instruments to the PET via the J1 interfacing port.
The book includes test programs for use as diagnostic aids and a comprehensive list of IEEE 488 Bus-compatible products. The book will also be an aid for those who want to know more about the IEEE 488 Bus (also referred to as the General Purpose Interface Bus (GPIB) and how it is implemented.

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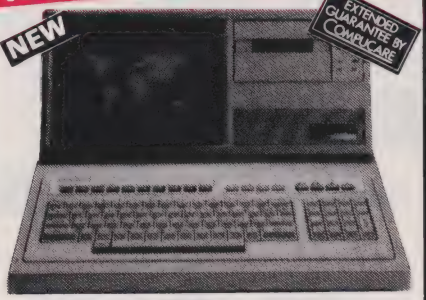

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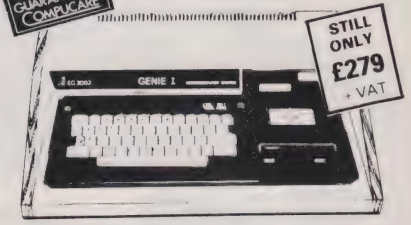

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MAGICAL MICRO▲

EMG Microcomputers, the London based dealer for the Exidy Sorcerer, have taken over the UK distribution company, Liveport Data Products. According to EMG's National Marketing Manager, Geoff Wilkinson, this new move will mean better training and service facilities to both dealers and customers plus an extended product range. Sounds good, EMG.

And speaking of the Sorcerer, EMG have wasted no time introducing a combined Display/Disc unit that has twin 5¼" floppy disc drives with a capacity of 1.2M and a P31 green phosphor screen with anti-glare characteristics. Mounted on a swivel base stand allowing total adjustment to suit operator comfort, the Display/Disc unit connects directly with the Sorcerer's 50 pin expansion bus and supports the CP/M operating system.

Transforming the Sorcerer into an integrated desktop computer system, the Display/Disc unit is priced at £1890. For further details of this unit and the rest of the Sorcerer range get in touch with EMG at the London Micro Centre, 47, Lower Belgrave Street, London SW1 or 'phone them on 01-730 8791.

THE LOCAL STORE

Three products have been introduced to support the Zynar Local Computer Network (LCN) system.

The CLO-2001, utilising dual double-sided 8" floppy discs, has been designed to provide Back-End Storage to the LCN system. Equipped with 1.26M of on-line storage capacity, the CLO-2001 supplied with cable and controller card for Apple II, retails at £3,000. The CLO-2002 and CLO-2003 are both Winchester hard disc units allowing users of the Zynar LCN system to employ shared high volume mass storage devices. The CLO-2002 has a formatted capacity of 16.5M and the CLO-2003 has 33M; the price of each unit is £6,000 and £9,000 respectively.

For details of these devices and the Zynar LCN system write to Zynar Ltd, 122/3, High Street, Uxbridge, Middlesex UB8 1JT or call them on 0895-59831.

FERRANTI TAKE AWAY▼

Ferranti have developed a unique Chinese processing system enabling the user to input and process Chinese text using a keyboard and VDU.

Using a standard QWERTY keyboard with two extra function pads inscribed with Chinese characters, text is input via Chinese phonetics. The software helps the user to select the correct character from a dictionary of over 8,000. The text is stored on floppy disc and can be edited, formatted into tables or forms, coded for telex transmission or printed on to paper.

So if you need to communicate in Chinese to your micro, communicate with Ferranti Computer Systems Ltd first. Their address is Simonsway, Wythenshawe, Manchester M22 5LA or you could always phone them on 061-499 3355.

READ ALL ABOUT IT

Here are two books that may help in that difficult task of getting 'computerised'.

The first is a book written by W E Bennett called 'Choosing a Small Computer — A Checklist Guide'. The book contains a list of over 300 questions grouped under ten main headings, such as display, keyboard, etc allowing managers to clearly define their needs and then match these against the equipment and services offered by different suppliers.

This book is available from Publications Sales at Management House, Parket Street, London WC2B 5PT, price £3 plus 10% p&p.

The other book is called 'Managing Systems Development'

and has been written by Jeffrey Keen. This is a reference book on the managerial aspects of developing and installing computerised business systems covering both the theory and practice of system development and project management.

The ISBN number of the publication is 0471 27839 4 and it is priced at £9.75. For further information contact John Wiley & Sons Ltd, Baffins Lane, Chichester Sussex P019 1UD or telephone 0243-784531.

MIND YOUR STORAGE ▼

A range of complete sub-systems has been announced providing a choice of extra storage capacity on floppy or Winchester disc drives together with host adaptors to S-100, Q-Bus, Multibus, Exorciser II, Apple and Tandy specifications.

Called the Minder range, the sub-systems can be configured as an 8″ floppy, dual floppy, floppy plus Winchester or Winchester plus tape. Capacities range from 240K (formatted) to 10M.

An intelligent controller is available as an option with up to four drives per controller. Software overlays are also available for Apple DOS3.3, Pascal, CP/M 2.2 and RT-11.

End user prices recommended start at £995 and rise to £4,750 for the 10M Winchester and tape version complete with controller. Full specifications are available from CPU Peripherals Ltd, Rodd Industrial Estate, Govett Avenue, Shepperton TW17 8AQ or by telephone on 98 46433.

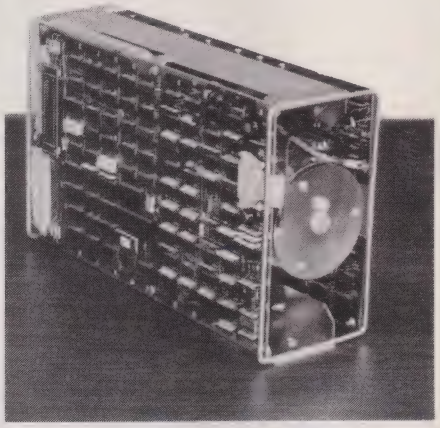
FLYING HIGH ▲

Complimenting the Eagle II Business System, Mediatech have introduced the Eagle I and Eagle III.

These new models share the same basic hardware specifications as the Eagle II such as an industry standard CP/M operating system, a Z80A CPU, 64K of memory and a 12″ anti-glare green CRT monitor with upper and lower case and true descenders.

The Eagle I has a single 384K formatted disc drive and is aimed at the correspondence management market. The Eagle III will handle business accounts and word processing requirements and offers 1.56M of formatted disc drive storage. The Eagle III also includes seven integrated accounting packages.

The prices of the Eagle I and Eagle III, hardware plus software, are £2,850 + VAT and £4,250 + VAT respectively. Both systems are available from Mediatech, Business Systems Division, Woodside Place, Alperton, Wembley, Middlesex HA0 1AX; telephone enquiries can be made on 01-903 4372.



THROWING A ▲ DISC DRIVE

PRIAM have upgraded their 35M DISKOS 3450 to form the new 8″ 70M Winchester disc drive DISKOS 7050.

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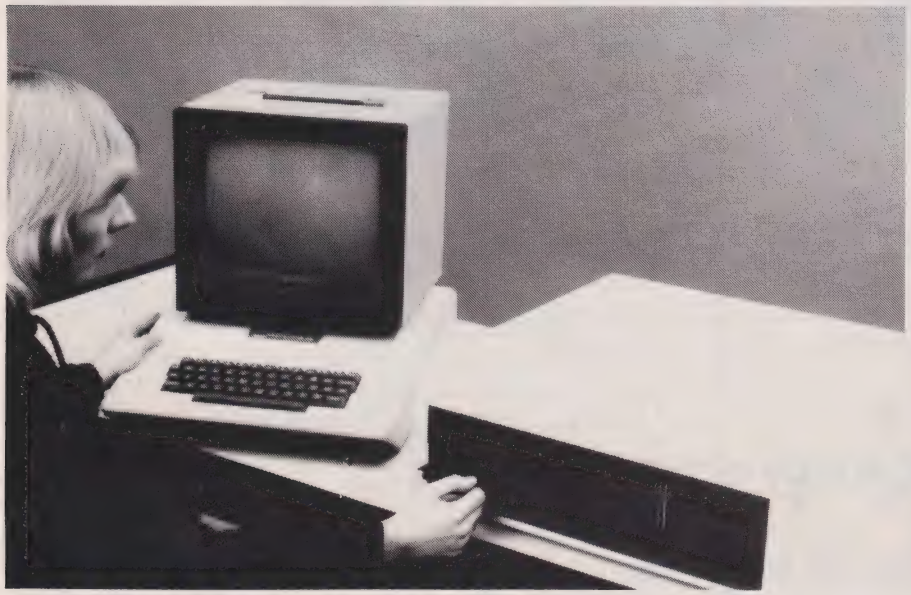
For detailed information, both technical and financial, write to PRIAM, 3096, Orchard Drive, San Jose, California 95134 or phone them on 408 946-4600 (not forgetting the code for the USA, of course!).



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SOFT SOURCES ▲

Volume One of the UK edition of the Tandy TRS-80 Applications Software Sourcebook is now available listing details and sources of over 500 UK-written applications programs to run on the TRS-80 Models I, II, III, Color and Pocket Microcomputers.

Each entry is indexed by, and appears under, one of eight catagories: Business/Accounting; Inventory Control; Education-Home; Education-Classroom; Games; Home-Personal; Specific Industry/Profession; and Statistics Maths.

Together with the existing USA version, this brings the total number of known TRS-80 programs to well over 2800.

The UK TRS-80 Sourcebook is priced at £3.95 and can be purchased at any of the 270 Tandy stores. For further information contact Tandy Corporation (Branch UK), Tameway Tower, Bridge Street, Walsall WS1 1LA or 'phone 0922-648181.

FORTH-COMING

Sharpsoft Ltd began publishing a periodical called 'Sharpsoft User Notes' back in January of this year as a non-profit making service to MZ-80K and MZ-80B computer users.

The 100-page January issue, the only one we've seen, is mostly devoted to FORTH including a FORTH tutorial for inexperienced programmers. Also included with the January issue are two cassette tapes containing a Fig-FORTH language package, a text editor for screen preparation and an 8080 Assembler written in FORTH.

Readers who wish to subscribe to the user notes or who wish to obtain further information on the availability of the January issue, write to Ron Evans, Sharpsoft Ltd, 86-90 Paul Street, London EC2A 4NE or 'phone him on 01-739 8559.

PRINTING SOFTWARE

Taking a new look at Linear Programming techniques, Caxton Software have released their first product, a management science program called Optimiser.

Designed to operate on the Apple microcomputer, Optimiser provides for a matrix of up to 2,000 elements; the number of variables and constraints can be altered to suit individual needs. The program uses the Simplex Method and offers short reports or a full Sensitivity Analysis of the Objective Function and Margins.

Complete with a couple of manuals and two copies of the program (for security reasons), Optimiser has been designed so that the user need not be aware of the complex maths involved.

Retailing at £295, Optimiser will soon be available for CP/M. For more information contact Caxton Software Publishing Co Ltd, 10-14, Bedford Street, Covent Garden, London WC2E 9HE or telephone 01-379 6502.

INDEX LINK

The Small Computer Program Index is a new bi-monthly publication compiled and edited by Alan Pritchard concentrating primarily, though not exclusively, on the needs of the microcomputer user at school, home, work and college.

Not only indexing the major personal and small computer magazines of the UK and the USA with a precise referencing system for finding any printed program but the index also includes programs listed in books.

The Small Computer Program Index is available from ALLM Books, 21, Beechcroft Road, Bushey, Watford, Herts WD2 2JU. Subscription for the six issues and annual index published in 1982 is £15 or $35.

KEEPING TABS

TABS have released a CP/M version of their successful Accounting Business Package.

Written in MBASIC and compiled, the new package is available for the Superbrain, NEC PC 8000, Sirius, Xerox 820 and Sharp PC 3201. TABS is also able to support other CP/M based machines and will transfer its software for a small fee.

There are 13 separate modules available and are priced at either £99 or £199; all are compatible with each other. For further details get in touch with TABS Ltd, Sopers House, Chantry Way, Andover, Hampshire SP10 1LU or telephone them on 0264-58933.

PLANNING AHEAD

Comshare, the international computer people, have now introduced a micro software package in the area of financial planning.

Called FASTPLAN, the system has the capacity of up to 300 rows by 60 columns and carries a full range of modelling facilities allowing the user to look forward or backward in time as well as carry out the normal financial functions, logical calculations and report writing.

Backing up FASTPLAN are two one-day training courses: one for advanced FASTPLAN users and another detailing the full potential of the CP/M. There is also a FASTPLAN Helpline service on 01-351 1251, available every

SOFT WARES

weekday from 8am to 6pm.

The documentation supplied with the package comprises a manual, tutorial, prompt card and a number of fact sheets. To help the user with really complex FASTPLAN models, Comshare offer a programming consultancy service whereby an expert will help write your programs.

For more details of FASTPLAN or any of the Comshare range of services, get in touch with them on 01-222 5665 or write to Comshare Ltd, 32/34, Great Peter Street, London SW1P 2DB.

EXTRA, EXTRA...►

Two newsletters have recently been launched covering the field of software for the microcomputer user.

The first is a UK publication called 'Software Brief-In' and is edited by Myles Hewitt. Providing up to date developments in the software market with evaluations of new products, Software Brief-In is available on subscription for £35 per year for ten issues. For more details get in touch with the publishers, Newtech Publishing Ltd, 7 Banstead Road, Purley, Surrey CR2 3ER.

'Programmer' is a newsletter offering tips on software techniques and information on the software market. Edited by Michael Comendul, former editor of 80 Microcomputing, it is available monthly at a price of $13 for six issues. Want to be better informed? Write to Programmer, PO Box 3210, Manchester, NH 03105, USA.

APPLE'S THE WORD▲

A word processing package for Apple III has now been launched, called Apple Writer III.

The package allows the user to compose, revise and print many different types of documents from memos to letters to books. There is a feature included called Word Processing Language (WPL) offering the facility for the user to write his own programs thus benefitting from automated word processing. The WPL also allows the user to merge information from VisiCalc III and to 'translate' typewriter shorthand into longhand automatically.

The Apple Writer III package is available at £135; for more information get in touch with Apple Computer (UK) Ltd, Finway Road, Hemel Hempstead, Herts HP2 7PS or telephone 0442-40573.

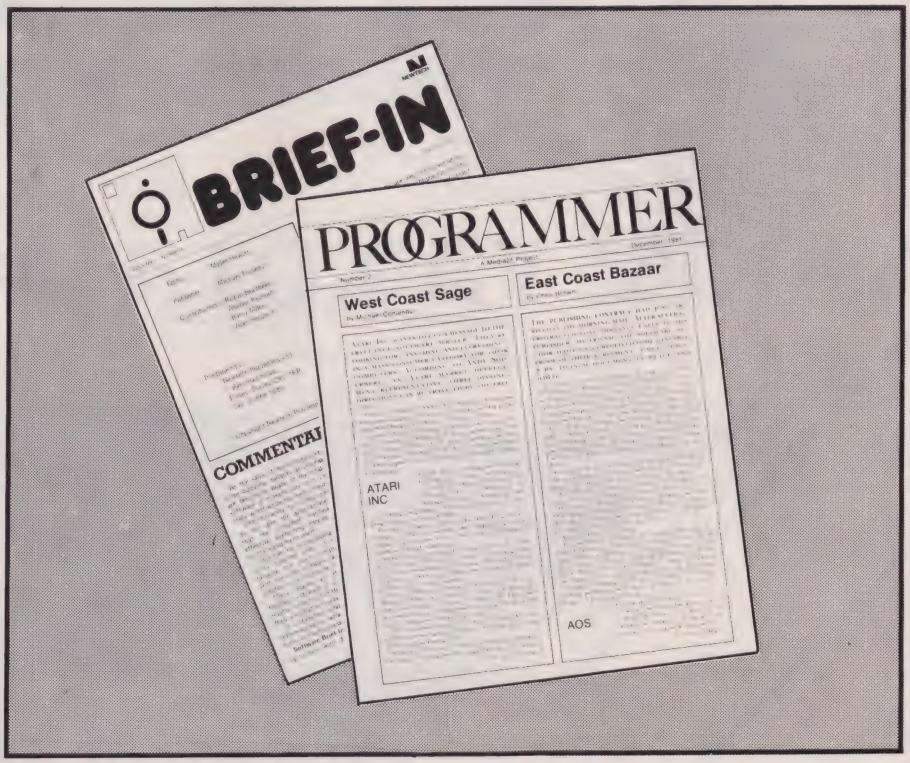
EXAM FEVER?

A new company, formed by a small group of science teachers, has produced two new programs for the ZX81 aimed specifically at the educational market.

'MARKBOOK' is a menu driven utility program allowing teachers to input their pupil's names, forms and marks, sorting the data into either alphabetical, form or rank order by marks obtained throughout the term. The program, priced at £4.50 also allows a printout to be made either as a page of class marks or as an individual pupil profile.

The second program is called 'REVISE' and is a complete package priced at £7.95 for students endeavouring to revise for their 'O' level Physics. A program is included in this package allowing a teacher to print out specific questions if required.

The company, SCISOFT, are nearing completion on a number of other projects including a REVISE package for 'O' level Chemistry, so students take note. If you want to know more, write to SCISOFT, 5 Minster Gardens, Newthorpe, Eastwood, Notts.



NEXT MONTH

PORTABLE POWER?

After years of writing books on computers and awarding his famous 'White Elephants' to the industry, Adam Osborne finally took the ultimate step and produced the Osborne I. Despite the fact it is portable, well . . .almost, and fairly reasonably priced as hardware goes, the main attraction seems to be the fact that you get several hundred pounds' worth of software thrown in for free.

Having humped the system up hill and down dale and generally put it through its paces, our reviewer will hopefully have recovered sufficiently to put pen to paper and report on his findings.

SIMULATING FORTH

The interest sparked off by our recent series on FORTH has been so great that even we were taken by surprise. As a result, next month we'll be publishing a rather novel BASIC simulator for FORTH operations so those of you who would like to try out the language — without actually having to buy a version of it for your system — can have a go. It certainly won't break any speed records, in fact it is extremely slow, but it does allow you to get to grips with Reverse Polish Notation.

PROGRAMMERS' TWO-STEP

OK, so you've learnt to program in BASIC. Now, perhaps, you'd like to have a go at assembly but you're put off by the fact that you can't alter your programs with the same ease as you can in BASIC. Well, what you need is our two-pass assembler which lets you write and modify the assembly code first and then turn it into machine code **without** destroying your original.

So, if you'd like a professional software tool to help you with your assembly language programming, don't miss out on our next issue!

ARE YOU SECURE?

Or, to be more precise, are your programs? In our next issue we'll be taking a look at a rather clever method of program protection which actually allows your programs to be copied but then won't let them run on any other system . . . frustrating in the extreme! We will also be publishing an extremely ingenious Voting Loader which guarantees perfect loading from cassettes at almost any speed. So, for your own peace of mind and the security of your programs and data, make sure you secure a copy of our June issue.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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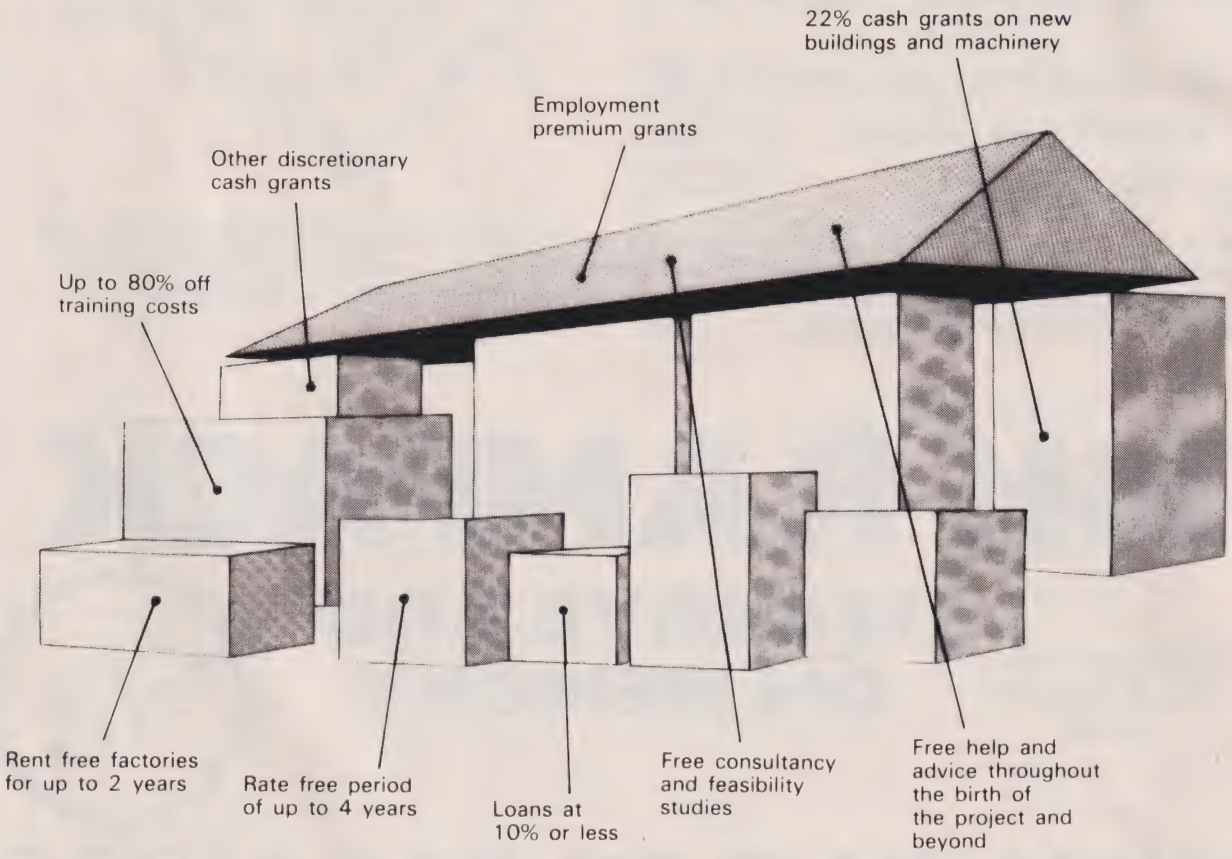

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G W Gallagher

Make your complex graphics simple by using symmetry to create them. This month we look at reflection and rotation about a single point.

Many of the patterns we strive to create on our computer, whether for business or pleasure, are often made up of a number of simple structures repeated around the screen.

How much easier would it be if, instead of laboriously creating each individual element we could simply create one and let the computer do the rest? The key to solving this problem is held in the title of this short series and, as we hope you will discover, allows you to let the computer take the strain.

A Case In Point

In this, the first of three articles on the subject, the particular point of interest is the point! Or, to be more precise, the symmetry of a particular shape about such a point. The point symmetry of any particular shape can be defined in terms of the following transformations: rotation about a point and reflection in a line.

Consider the capital letters A, B, C, E, X and O (illustrated in Fig. 1). The first four letters can be seen to have one axis of reflection whereas the letters X and O each have two axes of reflective symmetry.

Looking at some more examples, the letter, S, can be rotated through 180 degrees about the central point and appear to be unchanged; it is said to have rotation symmetry of order 2 (2 x 180° = 360°). The letter, X, can also be rotated through 180° yet has a symmetry of order 4, ie reflection in two axes and rotation about two points. The swastika pattern has a rotational symmetry through multiples of 90° thus having rotation symmetry of order 4.

The practicalities of reflection and rotation on the screen depend a lot on the type of graphics available on your computer. The following methods are based on the low and high resolution graphics available on the Apple. To make them adaptable for other graphics screens, the first examples will be based on a screen, W units wide and H units deep — where W and H are both integers.

Assuming we have a set of E points stored in two arrays, X(88) for the x co-ordinates and Y(88) for the y co-ordinates. 88 is the maximum number of terms in a particular array and is therefore a restriction on the number of points which may be included in an element of pattern (except when the pattern is generated using the paddles).

Reflection

If P_1 is one point to be plotted (Fig. 2a), its co-ordinates being X(I) and Y(I) related to the top left-hand corner of the screen, then P_2, the reflection of P_1 in the line which bisects the screen vertically, would have co-ordinates W-X(I) and Y(I). Having set the graphics mode, a simple one line program would show on the screen the original points and their reflections:

```
FOR I=1 TO E:HPLOT X(I),Y(I):
HPLOT W-X(I),Y(I):NEXT I
```

With two axes of reflection (Fig. 2b), the diagram suggests a more sensible origin of co-ordinates would be the centre of the screen, taken here as (W/2, H/2).

If X(I) and Y(I) are measured from the new origin then:

P_1 has co-ordinates W/2 − X(I), H/2 − Y(I)

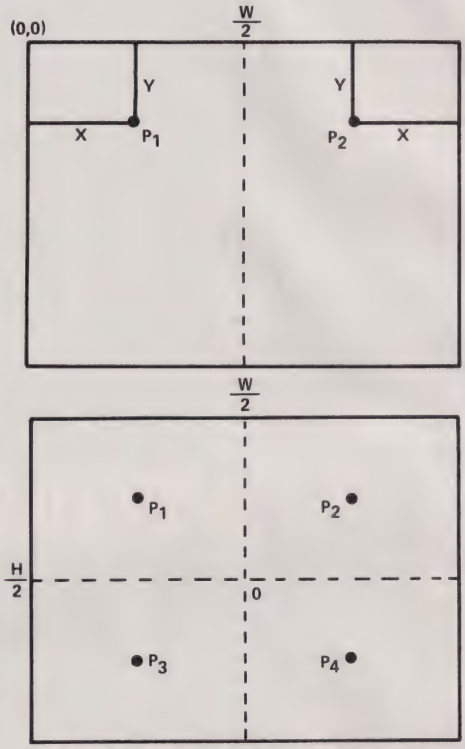


Fig. 2.a) Reflection of P_1 in the line W/2. b) Reflection of P_1 and P_2 in the line H/2.

P_2 has co-ordinates W/2 + X(I), H/2 + Y(I)

P_3 has co-ordinates W/2 − X(I), H/2 + Y(I)

P_4 has co-ordinates W/2 + X(I), H/2 + Y(I)

The program to plot the four points which make the pattern symmetrical about two axes is then:

```
FOR I=1 TO E:HPLOT W/2-X(I),H/2-Y(I):
HPLOT W/2+X(I),H/2-Y(I):
HPLOT W/2-X(I),H/2+Y(I):
HPLOT W/2+X(I),H/2+Y(I):NEXT I
```

If a high resolution graphics screen is available, we can illustrate the effect of a pattern with any number of axes of reflection and combine all these possibilities into one program. To do this, we need to use the matrix:

$$\begin{matrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{matrix}$$

This matrix will work out the co-ordinates of the reflection of any point (x,y) in the line $y = x \tan \theta$.

Thus if X_1, Y_1 are the co-ordinates of the point generated then:

$X_1 = x \cos 2\theta + y \sin 2\theta$
$Y_1 = x \sin 2\theta - y \cos 2\theta$ ⟩ A

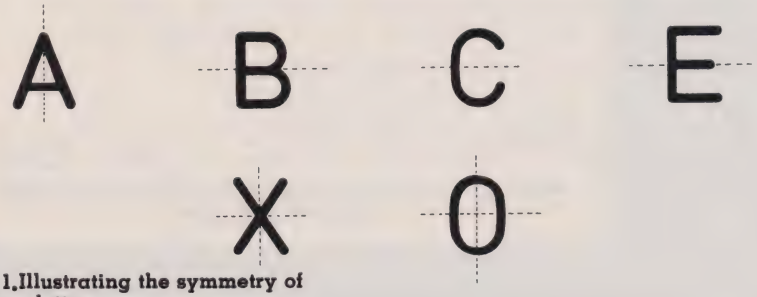
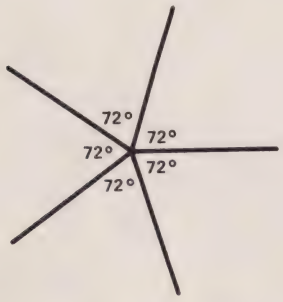


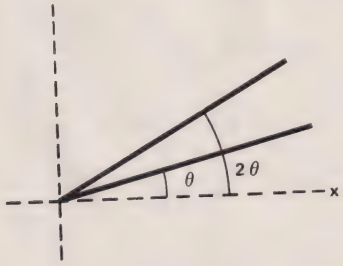
Fig. 1.Illustrating the symmetry of various letters.

The angle is determined by the number of axes of reflection. For example, if there are 5 axes, then the angle between the axes would be 72 degrees or $2\pi/5$ radians.



If we measure the angle from the positive direction of the x-axis, the angle, θ, will take in turn the values of $2\pi/5$, $2x\,2\pi/5$, $3x\,2\pi/5$, $4x\,2\pi/5$ and $5x\,2\pi/5$.

Generalising this, if a figure has n axes of reflection, the angle, θ, between each axes will be multiples of $2\pi/n$ radians.



Consider the point, P, whose co-ordinates, with reference to 0 as origin are X(I), Y(I), and its reflections, P_1, in the x-axis. The co-ordinates of P_1 with reference to 0 are X(I) and $-Y(I)$. These values are important, because the complete diagram is drawn most easily by reflecting this pair of points in each of the other axes of symmetry.

The program now uses W = 280 and H = 160, to fit the high resolution graphics screen 1 of Apple. To plot the initial shape:

```
1160  HOME:HGR:HCOLOR=3:FOR I=1 TO E:
      HPLOT 140+X(I),80-Y(I):NEXT I
```

With n axes of reflection, the next step is to find the angle between axes (in radians). This is realised in the following equation:

```
1170  T=6.283/N
```

Then, using equations A, the positions of the new points on the screen are found by adding 140 and 80 respectively to the calculated co-ordinates:

```
1180  FOR I=1 TO N:FOR K=1 TO E:
      P=140+X(K)*COS(I*T)+
      Y(K)*SIN(I*T)
1190  Q=80-X(K)*SIN(I*T)+
      Y(K)*COS(I*T):HPLOT P,Q
1200  P1=140+X(K)*COS(I*T)-
      Y(K)*SIN(I*T)
1210  Q1=80-X(K)*SIN(I*T)-
      Y(K)*COS(I*T):HPLOT P1,Q1:
      NEXT K:NEXT I
```

Rotation

Symmetry by rotation can be dealt with in a similar way to reflection. If a shape has a rotational symmetry order of 5, then the shape can be rotated through multiples of 72 degrees or $2\pi/5$ radians, and appear to be identical with the original.

The element of pattern described above has therefore to be repeated at multiples of 72 degrees about the centre point. In fact, taking E as the total number of points and N as the order of rotational symmetry, the program would follow a similar line to the reflection program.

However, the matrix used for rotation through an anticlockwise angle, θ, is:

$$\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$$

The values of θ to be used will be multiples of $2\pi/5$ radians, and if X1 and Y1 are the new co-ordinates resulting from applying the matrix to the point (x,y) then:

$$\left.\begin{aligned} X1 &= x\cos\theta - y\sin\theta \\ Y1 &= x\sin\theta + y\cos\theta \end{aligned}\right\rangle \quad B$$

The program would then plot the original point first:

```
1280  HOME:HGR:HCOLOR=3:FOR I=1 TO E:
      HPLOT 140+X(I),80-Y(I):NEXT I
```

Find the smallest angle of rotation (in radians):

```
1290  T=6.283/N
```

Then, using equations B and adding the screen co-ordinates of 0, the complete shape can be illustrated on the screen:

```
1300  FOR I=1 TO N:FOR K=1 TO E:
      P=140+X(K)*COS(I*T)-
      Y(K)*SIN(I*T)
1310  Q=80-X(K)*SIN(I*T)-Y(K)*
      COS(I*T):HPLOT P,Q:NEXT K:
      NEXT I
```

The Pattern Screen

Using Apple, the program allows 3 different methods of providing the pattern element.

Using the data statement

```
1500  DATA 1,1,3,1,5,1,7,1 ETC
```

The numbers represent the points (1,1), (3,1), (5,1) and (7,1) relative to the centre of the screen as origin. The order in which the points are listed does not matter, but it is important that for each point the x co-ordinate should be followed by the y co-ordinate of the ***same*** point.

```
940   RESTORE:FOR I=1 TO 87:
      READ X(I),Y(I):NEXT I
950   E=87:GOTO 1110
```

Line 940 reads in the data for 87 points and places the values in the arrays for x and y co-ordinates. Line 950 passes on the total number of points to the pattern-making programs.

Using the paddles When using the paddles, the x and y co-ordinates are directly related to the readings from the paddles. P0 represents the reading from paddle 0, and P1 the reading from paddle 1 (see Fig. 4). The x co-ordinate = P0/ 1.9 and the y co-ordinate = P1/1. 6.

Fig. 3. A single element, first rotated then reflected to form a complete pattern.

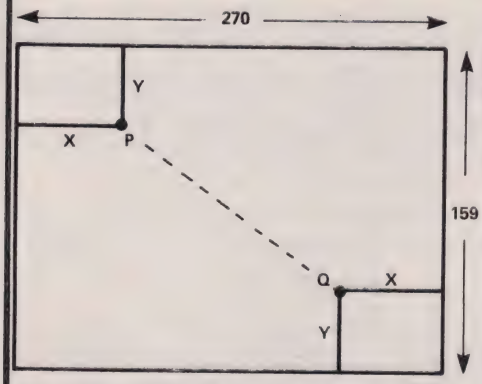


Fig. 4.The point P is rotated through 180° to form Q.

These are the values related to the Apple screen co-ordinates; the origin being in the top left-hand corner of the screen.

```
4110  P0=PDL(0)
4115  X=P0/1.9:X2=270-X
4120  P1=PDL(1):Y=P1/1.6:Y2=160-Y
4130  HPLOT X2,Y2:HPLOT X,Y
```

The point Q(X2,Y2) is the point resulting from the rotation of the point P(X1,Y1) through 180 degrees about the centre.

Plotting continued in this way will build up a pattern which has rotational symmetry of order 2. For rotational symmetry of order 4, the scaling factors have to be changed from 1.9 and 1.6 to 3.2 and 3.2 so the resulting pattern is enclosed in square (Fig. 5).

The program to plot the 4 points resulting from one pair of paddle readings is:

```
5020  P0=PDL(0)
5025  P1=PDL(1)
5030  X=P0/3.2:Y=P1/3.2:X2=159-Y:
      X3=159-X:X4=Y
5035  Y2=X:Y3=159-Y:Y4=159-X
5050  HPLOT X,Y:HPLOT X2,Y2:
      HPLOT X3,Y3:HPLOT X4,Y4
```

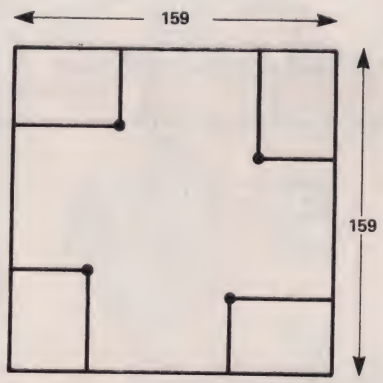


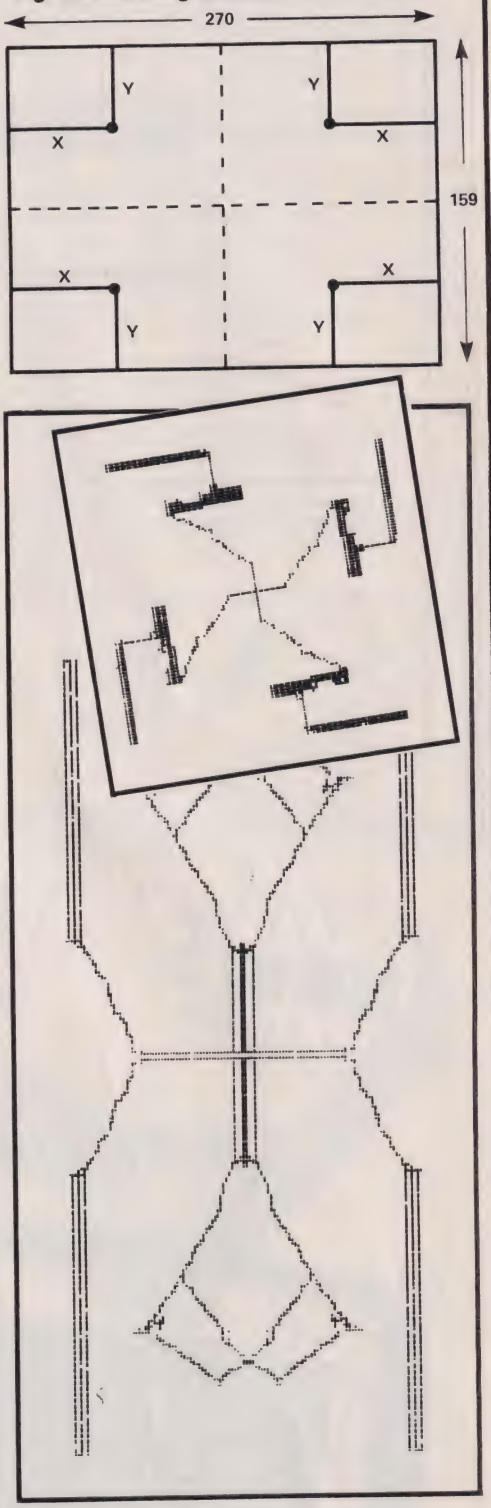
Fig. 5.Illustrating rotational symmetry of order 4.

Program Listing

```
10  DIM X(88),Y(88)
100  HOME : VTAB 6: HTAB 9: PRINT "**********************"
110  HTAB 9: PRINT "*                    *"
120  HTAB 9: PRINT "*   POINT SYMMETRY   *"
130  HTAB 9: PRINT "*                    *"
140  HTAB 9: PRINT "*   G.W.GALLAGHER    *"
150  HTAB 9: PRINT "*        1982        *"
160  HTAB 9: PRINT "*                    *"
170  HTAB 9: PRINT "**********************"
180  FOR I = 1 TO 1000: NEXT I
190  HOME : PRINT "TYPE 1 FOR PADDLE SYMMETRY"
200  VTAB 3: PRINT "     2 FOR SYMMETRY WITHOUT PADDLES"
205  VTAB 5: PRINT "     3 TO END"
210  INPUT A: IF (A - 1) * (A - 2) * (A - 3) <  > 0 THEN 210
215  ON A GOTO 220,900,600
220  PRINT "TYPE 1 FOR REFLECTIVE SYMMETRY"
230  PRINT "     2 FOR ROTATIONAL SYMMETRY"
240  INPUT A: IF (A - 1) * (A - 2) <  > 0 THEN 240
245  ON A GOTO 250,530
250  HOME : PRINT "USING THE PADDLES YOU WILL BE ABLE TO"
260  VTAB 3: PRINT "PRODUCE PATTERNS WITH 1 OR 2 AXES OF"
270  VTAB 5: PRINT "SYMMETRY"
280  VTAB 10: PRINT "TYPE 1 FOR 1 AXIS,2 FOR 2 AXES": INPUT R: GOTO 6000
530  HOME : PRINT "USING THE PADDLES YOU WILL BE ABLE"
540  VTAB 4: PRINT "TO PRODUCE PATTERNS WITH ROTATIONAL"
550  VTAB 7: PRINT "SYMMETRY THROUGH 1 OR 2 RIGHT ANGLES."
560  VTAB 20: PRINT "TYPE 1 FOR ONE RIGHT ANGLE,2 FOR 2"
570  INPUT R
580  GOTO 4000
600  END
900  HOME : PRINT "TYPE 1 TO SEE AN EXAMPLE"
910  PRINT "     2 TO FORM YOUR OWN PATTERN ELEMENT"
920  INPUT A: IF (A - 1) * (A - 2) <  > 0 THEN 920
930  ON A GOTO 940,1000
940  RESTORE : FOR I = 1 TO 87: READ X(I),Y(I): NEXT I
950 E = 87: GOTO 1110
1000  HOME
1002  PRINT "1,1                16,1"
1003  PRINT "   +++++++++++++++++"
1004  PRINT "   +++++++++++++++++"
1005  PRINT "   ++++++++++++++0++  THE O IS AT 14,3"
1006  PRINT "   +++++++++++++++++"
1007  PRINT "   +++++++++++++++++"
1008  PRINT "   +++++++++++++++++"
1009  PRINT "   +++++++++++++++++"
1010  PRINT "   +++++++++++++++++"
1011  PRINT "   +++++++++++++++++"
1012  PRINT "   +++++++++++++++++"
1013  PRINT "   +++++++++++++++++"
1014  PRINT "   +++++++++++++++++"
1015  PRINT "   ++++++++++S+++++  THE S IS AT 11,13"
1016  PRINT "   +++++++++++++++++"
1017  PRINT "   +++++++++++++++++"
1018  PRINT "   +++++++++++++++++"
1019  PRINT "1,16               16,16"
1020 I = 1
1030  VTAB 20: PRINT "A POINT,PLEASE, IN THE FORM A,B"
1035  PRINT "TYPE 0,0 WHEN YOUR SHAPE IS COMPLETE"
1040  INPUT A,B:D = B + 1:C = A + 3
1045  IF A = 0 AND B = 0 THEN 1070
1050 X(I) = A:Y(I) = B: VTAB D: HTAB C: PRINT "#"
1055 I = I + 1: IF I > 88 THEN 1065
1060  GOTO 1030
1065  HOME : PRINT "THERE IA A MAXIMUM NUMBER OF POINTS(88).YOUR PATTERN I
     S ASSUMED TO BE COMPLETE"
1070 E = I - 1
1110  HOME : PRINT "TYPE 1 FOR REFLECTIVE SYMMETRY"
1120  PRINT "     2 FOR ROTATIONAL SYMMETRY"
1130  PRINT "     3 TO MAKE A NEW ELEMENT"
1135  PRINT "     4 TO END"
1140  INPUT A: IF (A - 1) * (A - 2) * (A - 3) * (A - 4) <  > 0 THEN 1140
1145  ON A GOTO 1150,1270,190,600
1150  HOME : INPUT "HOW MANY LINES OF SYMMETRY";N
1160  HOME : HGR : HCOLOR= 3: FOR I = 1 TO E: HPLOT 140 + X(I),80 - Y(I): NEXT
     I
1170 T = 6.283 / N
1180  FOR I = 1 TO N: FOR K = 1 TO E:P = 140 + X(K) *  COS (I * T) + Y(K) *
     SIN (I * T)
1190 Q = 80 - X(K) *  SIN (I * T) + Y(K) *  COS (I * T): HPLOT P,Q
1200 P1 = 140 + X(K) *  COS (I * T) - Y(K) *  SIN (I * T)
1210 Q1 = 80 - X(K) *  SIN (I * T) - Y(K) *  COS (I * T): HPLOT P1,Q1: NEXT
     K: NEXT I: GOSUB 8000: GOSUB 9000
1220  HOME : TEXT : GOTO 1110
1270  HOME : INPUT "WHAT ORDER OF ROTATIONAL SYMMETRY";N
1280  HOME : HGR : HCOLOR= 3
1290 T = 6.283 / N
1300  FOR I = 1 TO N: FOR K = 1 TO E:P = 140 + X(K) *  COS (I * T) - Y(K) *
     SIN (I * T)
1310 Q = 80 - X(K) *  SIN (I * T) - Y(K) *  COS (I * T): HPLOT P,Q: NEXT K
     : NEXT I: GOSUB 8000: GOSUB 9000
```

```
1320  HOME : TEXT : GOTO 1110
1400  GOTO 190
1500  DATA 1,1,3,1,5,1,7,1,9,1,11,1,13,1,15,1,17,1,19,1,21,1,23,1,25,1,27,
      1,29,1
1510  DATA 3,2,7,2,5,3,9,3,11,3,13,3,15,3,17,3,19,3,21,3,23,3,25,3,27,3,29
      ,3,31,3,7,4,11,4
1520  DATA 9,5,13,5,17,5,19,5,21,5,23,5,25,5,27,5,30,5,32,5,11,6,15,6,19,6
      ,23,6,26,6,28,8,13,7,17,7,21,7,25,7
1530  DATA 31,7,33,7,15,8,19,8,23,8,28,8,17,9,21,9,25,9,27,9,30,9,32,9,19,
      10,23,10,21,11,25,11,27,11,29,11,31,11,23,12,25,13,27,13,29,13
1540  DATA 29,15,31,16,33,17,35,18,31,14,33,15,35,16,33,13,35,13,35,11,34,
      9,33,11
4000  HOME : REM  PADDLE SYMMETRY
4020  GOSUB 8200
4080  GOSUB 9000
4090  IF R = 2 THEN  GOTO 5000
4100  HGR
4101  HCOLOR= A
4105 T = 0
4110 P0 =  PDL (0)
4115 X = (P0 / 1.9):X2 = 270 - X
4120 P1 =  PDL (1):Y = (P1 / 1.6):Y2 = 160 - Y
4130  HPLOT X2,Y2: HPLOT X,Y
4160 T = T + 1: IF T < 100 THEN  GOTO 4110
4165 T = T - 100
4170  GOSUB 8300
4190  IF B = 1 THEN  GOTO 4300
4200  VTAB 21: HOME : GOTO 4110
4300  GOSUB 8000: GOSUB 9000: TEXT : GOTO 190
5000  HGR : HCOLOR= 3
5015 T = 0
5020 P0 =  PDL (0)
5025 P1 =  PDL (1)
5030 X = P0 / 3.2:Y = P1 / 3.2:X2 = 159 - Y:X3 = 159 - X:X4 = Y
5035 Y2 = X:Y3 = 159 - Y:Y4 = 159 - X
5050  HPLOT X,Y: HPLOT X2,Y2: HPLOT X3,Y3: HPLOT X4,Y4
5200 T = T + 1: IF T < 100 THEN  GOTO 5020
5300 T = T - 100
5310  GOSUB 8300
5330  IF B = 1 THEN  GOTO 5400
5340  VTAB 21: PRINT "                                                    "
5350  PRINT "                "
5360  GOTO 5020
5400  GOSUB 8000: GOSUB 9000: TEXT : GOTO 190
6000  HOME
6020  GOSUB 8200
6080  GOSUB 9000: IF R = 2 THEN 7000
6090  HGR : HCOLOR= 3
6095 T = 0
6100 P0 =  PDL (0):X = P0 / 1.9:X2 = 270 - X:P1 =  PDL (1):Y = P1 / 1.6: HPLOT
      X2,Y: HPLOT X,Y:T = T + 1
6110  IF T < 100 THEN 6100
6120 T = T - 100
6130  GOSUB 8300
6150  IF B = 1 THEN 6170
6160  VTAB 21: HOME : GOTO 6100
6170  GOSUB 8000
6300  GOSUB 9000: TEXT : GOTO 190
7000  HGR : HCOLOR= 3
7010 P0 =  PDL (0):X = P0 / 1.9:X2 = 270 - X:P1 =  PDL (1):Y = P1 / 1.6:Y2
      = 159 - Y: HPLOT X,Y: HPLOT X,Y2: HPLOT X2,Y: HPLOT X2,Y2:T = T + 1
7020  IF T < 100 THEN 7010
7030  GOSUB 8300
7050  IF B = 1 THEN 7100
7060  VTAB 21: HOME : GOTO 7010
7100  GOSUB 8000: GOSUB 9000: TEXT : GOTO 190
8000  VTAB 21: PRINT "TYPE 1 TO PRINT THIS,2 NOT TO PRINT": INPUT F: IF (F
      - 1) * (F - 2) <  > 0 THEN 8000
8010  IF F = 2 THEN 8150
8020 D$ =  CHR$ (4)
8100  PRINT D$;"PR#1"
8110  POKE  - 12528,7
8115  POKE  - 12524,0
8120  POKE  - 12529,255
8130  PRINT  CHR$ (17)
8140  PRINT D$;"PR#0"
8150  RETURN
8200  VTAB 5: PRINT "THE PADDLE NUMBERED 0 WILL MOVE YOUR"
8210  VTAB 7: PRINT "LINE HORIZONTALLY,AND THE PADDLE"
8220  VTAB 9: PRINT "NUMBERED 1 VERTICALLY"
8230  RETURN
8300  VTAB 21: PRINT "TYPE 1 TO FINISH,2 TO CONTINUE"
8310  INPUT B: IF B < 1 OR B > 2 THEN  GOTO 8300
8320  RETURN
9000  VTAB 21: PRINT "PRESS ANY KEY WHEN YOU ARE                "
9010  PRINT "READY TO CONTINUE"
9020  GET A$: IF A$ = "" THEN  GOTO 9020
9030  VTAB 21: PRINT "                                                    "
9040  PRINT "                "
9050  RETURN
```

Fig. 6. Illustrating reflection in one axis.



For reflection in one axis (Fig. 6):

```
6100  P0=PDL(0):X=P0/1.9:X2=270-X:
      P1=PDL(1):Y=P1/1.6:
      HPLOT X2,Y:HPLOT X,Y
```

For reflection in two axes:

```
7010  P0=PDL(0):X=P0/1.9:X2=270-X:
      P1=PDL(1):Y=P1/1.6:Y2=159-Y:
      HPLOT X,Y:HPLOT X,Y2:
      HPLOT X2,Y:HPLOT X2,Y2
```

In each paddle program, the letter T has been used as a counting device. After 100 readings, there is a temporary halt while the operator decides whether or not to continue.

Using the keyboard To build up an element of pattern from the keyboard, a 16 by 16 diagram is shown on the screen (line 1000 onwards). The position of a point is given in terms of co-ordinates with (1,1) in the top left-hand corner and (1,16) in the bottom left-hand corner.

When a point is typed in, the co-ordinates are converted to give the position horizontally and vertically in the square on the screen, and places a # at the correct spot. It is thus possible to see the pattern building up.

```
1030  VTAB 20:PRINT "A POINT PLEASE,
      IN THE FORM A,B"
1035  PRINT "TYPE 0,0 WHEN YOUR SHAPE
      IS COMPLETE"
1040  INPUT A,B:D=B+1:C=A+3
1045  IF A=0 AND B=0 THEN 1070
1050  X(I)=A:Y(I)=B:VTAB D:HTAB C:
      PRINT "#"
1055  I=I+1:IF I>88 THEN 1065
1060  GOTO 1030
```

A 16-point square is not a large unit on the HGR screen, but it is a reasonable size for fitting on the basic screen as the pattern unit is prepared. During this process, it is important that the screen should not scroll if the pattern element is not to appear in a confused state.

There has been no attempt to introduce colour anywhere in the program, white has been used as the drawing-colour throughout. The use of colour has been left to individual taste.

The subroutine at 8000 provides the opportunity to print out the pattern on the screen using any suitable printer. The instructions in this subroutine is for the Silentype printer.

The '6809' centre

Micro-Computer Hardware

FUJITSU MICRO COMPUTER "JUST ARRIVED FROM JAPAN"			EX VAT	INC VAT
Fujitsu	Micro 8 Twin '6809' 64K computer		868.70	999.00
Fujitsu	Dual 5" Disc Drive with Adaptor (656 Kb)		1216.52	1399.00
Fujitsu	Z-80	Alternative Processor Card	50.00	57.50
APPLE ALTERNATIVE PROCESSOR CARDS				
Stellation	The Mill '6809' With Disk Assembler		239.13	275.00
Stellation	The Mill '6809' With Pascal Speed up kit		239.13	275.00
Microsoft	Z-80 Softcard, With CP/M and Basic		191.30	220.00
SOUTH WEST TECHNICAL PRODUCTS CORP. – SS-50c MICRO-COMPUTERS				
SWTPC	S/09-64K	64K Computer with 3 ports (2 MHz)	1448.70	1666.00
SWTPC	69/A	8K Computer with 1 port (1 MHz)	634.78	730.00
SWTPC	MP-09	6809 Processor board (S-Bug, 1 MHz)	200.00	230.00
SWTPC	MP-S2	Dual Serial Interface	110.00	126 50
SWTPC	MP-L2	Dual Parallel Interface	110.00	126.50
SWTPC	8209	Intellegent 9" Terminal	860.00	989.00
SWTPC	DMF-2	Dual 8" DS/DD disk drive (2.5 Mb)	2347.83	2700.00
SWTPC	D-5	Dual 5" DS/SD disk drive (740 Kb)	1216.52	1399.00
'77-68' MICRO-COMPUTER – SOLE UK DISTRIBUTOR FOR THIS 8" x 8" PCB KIT SYSTEM				
'77-68'	'6800' CPU	With 256 Bytes Ram & Parallel Port	10.43	12.00
'77-68'	MON 1	Software Monitor & 2 Serial Ports	10.43	12.00
'77-68'	MON 2	Rom Monitor with Serial Port	10.43	12.00
'77-68'	'6809' CPU	With 1 K Ram, 2K Rom & 2 Ports	10.43	12.00
'77-68'	Cassette	300-2400 Baud Cassette Interface	5.22	6.00
'77-68'	4K Ram	4K Static Ram Board	10.43	12.00
'77-68'	Dynaram	32K Dynamic Ram Board	10.43	12.00
'77-68'	VDU	40 x 24 Memory mapped VDU Board	10.43	12.00
'77-68'	PIO	2 Parallel I/O Ports & Timer	10.43	12.00
'77-68'	ROM A	8 x 2708 or 2716 Rom Board (8K-16K)	10.43	12.00
'77-68'	Prom Prog	2708 Eprom Programmer Board	10.43	12.00
'77-68'	Disk CTRL	Hard Sectored Disk Controller Board	10.43	12.00
'77-68'	System manual – '6800' CPU, MON 1 & 4K Ram Board		4.35	5.00
'77-68'	Design notes for other boards (each)		.87	1.00

Micro-Computer Software

'6800' CASSETTE SYSTEMS SOFTWARE				
SWTPC	CST-012	Disassembler, with move function	10.00	11.50
SWTPC	CST-014L	Text Editor with source listing	28.00	32.20
SWTPC	CST-015L	Two Pass Assembler with source list	28.00	32.20
SWTPC	CST-016L	Text Processor with source listing	28.00	32.20
SWTPC	CST-017L	Program Relocator with source list	16.09	18.50
SWTPC	CST-003	8K Basic Interpreter V2.3	15.22	17.50
'6809' CASSETTE SYSTEMS SOFTWARE "DIRECT FROM THE STATES"				
TSC	'6809' Cassette Text Editor		60.78	69.90
TSC	'6809' Cassette Macro Assembler		60.78	69.90
TSC	'6809' Cassette Basic		60.78	69.90
FLEX9 OPERATING SYSTEM SOFTWARE, ON 5" OR 8" DISKS – FOR MOST '6809' MACHINES				
TSC	Flex	Configurable + Editor & Assembler	120.00	138.00
TSC	TS-003	Sort/Merge Package	58.26	67.00
TSC	TS-004	Debug Package	58.26	67.00
TSC	TS-005	Disk Utilities	46.96	54.00
TSC	TS-006	Text F rocessor	58.26	67.00
TSC	TS-009	Editor & Macro Assembler	69.57	80.00
TSC	TS-017	Disk & Memory Diagnostics	52.17	60.00
TSC	TS-007	Basic	52.17	60.00
TSC	TS-008	Extended Basic	75.65	87.00
TSC	TS-016	XBasic Pre-Compiler	40.87	47.00
TSC	TS-019	Pascal	145.22	167.00
Washington	R.M.S.	Record Management System	145.22	167.00
C.S.C.	Tabula Rasa	Spreadsheet Tabulation Program	120.00	138.00
Microware	Stylograph	Word-Processing System	173.04	199.00

Books (Please add 1.50 p&p per order)

Osbourne 4 & 8-Bit Microprocessor Handbook	13.60	13.60
Osbourne 16-Bit Microprocessor Handbook	13.60	13.60
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Owen Bishop

Continuing our micro-controlled security system project, we complete the construction and begin the programming.

The month before last we outlined the concept behind a domestic security system based on the various modules we have constructed as Microlinks. We named the system The ARGUS after the mythological Greek monster with 100 eyes — it also ties up nicely with our company name!

In this month's article we continue with the construction and testing of the system and give you some ideas on how to implement The ARGUS in your own home. Please note that the figure numbers continue from the previous article, any references to Figs 1 to 15 or Tables 1 to 4 should be checked against the March issue.

Construction

The prototype ARGUS is bolted to the front panel of an Acorn System 1 giving easy access to the keyboard, display and the cassette connector. The case contains the power supply, the logic board, the output driving circuits and (optionally) the Alarm Clock interface (see photo). An array of 1 mm sockets on the rear of the case can be used for connecting the system to peripherals.

Build the power supply first (Fig. 16). It provides an unregulated supply of 1.6 A at 12 V (nominal). If all devices in the system are operating simultaneously, a supply of about 1.4 A (at 12 V or 5 V) is needed to cover all requirements for Phase 2. This allows for a 0.6 A supply to the micro and up to four external relays each taking 50 mA. The rectifier bridge is mounted directly on the secondary terminals of T1, its + and − terminals being connected to the power/driver board (Fig. 17); an LED acts as a power-on indicator. The regulated supply passes through a thyristor preventing restoration of power to the micro and The ARGUS if there is a failure of the mains supply. Mains failure usually leads to loss of program, and haphazard restoration could cause bizarre happenings, some of them possibly dangerous. It is desirable that the system should not be restarted until you are able to supervise it. Button R2 is pressed to power-up the system. This applies a high pulse to the gate of SCR1, making it conduct. Then, power remains on until the supply is interrupted again.

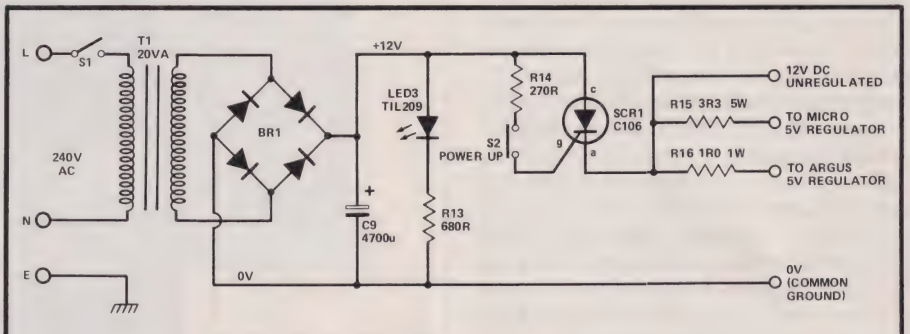


Fig. 16. The power supply circuit necessary for The ARGUS and the Acorn.

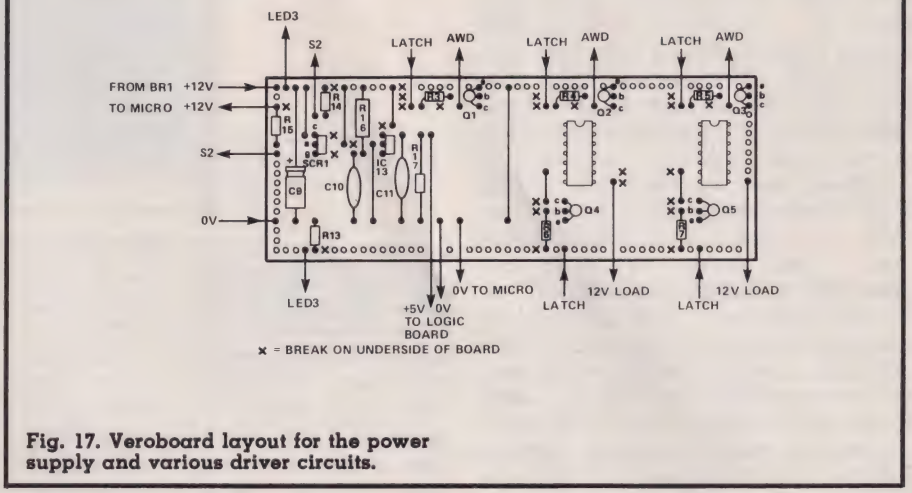


Fig. 17. Veroboard layout for the power supply and various driver circuits.

The micro and The ARGUS each have their own 5 V regulator (Fig. 18 shows the ARGUS regulator circuit). Although most regulators can happily accept a 12 V input, the amount of heating of the regulator will be reduced (hence the risk of thermally-induced cut-out) and if a dropper resistor is going to be used to reduce the voltage a little before regulation, use wire-wound resistors as indicated. SCR1 and the 5 V regulators may need heat sinks; these can be cut from sheet aluminium or purchased ready-made.

The driver circuits can be assembled next or left until after the logic board is complete. Note that there are vacant spaces on the board for the two additional relays and the extra transistors needed in Phase 2. The relay's switches are shown connected to the 12 V supply via strip E, though connections to other DC supplies are permissible (see above).

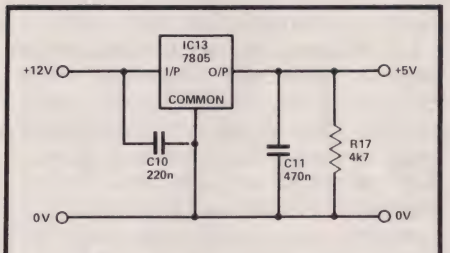


Fig. 18. The three-terminal regulator connections for The ARGUS.

Wiring Up

The most exacting task is wiring up the logic board. If you are intending to implement Phase 2 eventually, it is worth considering using wire-wrap. In any case, do use IC sockets (or Soldercon strip) so that ICs may be removed to isolate parts of the circuit when tracing faults. The recommended board is ready to take the ICs without any need to cut strips. Figure 2 shows the layout with one spare space for a 14-pin or 16-pin device. This could be used to

make additional bistables or to provide inversion of inputs as required for your version of the system. The +5 V line and 0 V lines are bus strips extending from the +5 V and ground pads at either end of the IC area. These run beneath the devices and may be joined to the appropriate pins by simple wire loops. Solder 100 nF decoupling capacitors as shown in Fig. 2. Pin connections are given in Figs. 4-8 and 12. As explained above, connection to the micro is by way of the usual PCB plugs soldered to the top I/O pad (see Table 3) and other connections are by terminal pins in the top and bottom pads (Tables 4 and 5).

Wire and test the two decoders first. Make inputs high or low by temporary connections to the 0 V or +5 V lines. Outputs should all be high except for the one corresponding to the input binary code. For example, if B7 and B6 are high (Fig. 4) and B5 and B4 are low, the code will be 1100 (12 in decimal). All outputs of IC1 and all outputs of IC2 **except** output 4 (W12) will be high, output 4 will be low.

Next, wire up the buffers (ICs 3,4), the bistables (ICs 8,9) and the interrupt gates (ICs 10,11). This section is best tested by using the micro. Program A can be used for Phase 1 or Phase 2. It sets up the I/O device, resets the bistables and then waits for an interrupt. On receiving an interrupt (IRQ or NMI), it jumps to the interrupt subroutine. Here it scans and reads the inputs, storing the result in memory at 0200 Hex to 0207 Hex. To use this program, temporarily connect all input pins to +5 V. Make any one of these low to cause an interrupt, the micro then completes its task rapidly and returns to the monitor. The memory locations may then be examined. The first digit will be 0 to 7 (indicating the various outputs to the decoders) and the second digit indicates the state of the input lines. For example, if SECURE input is made high, the registers should read:

```
0020      0F  = 0000 1111
0021      1F  = 0001 1111
0022      2E  = 0010 1110
0023-0027 are not used in Phase 1
```

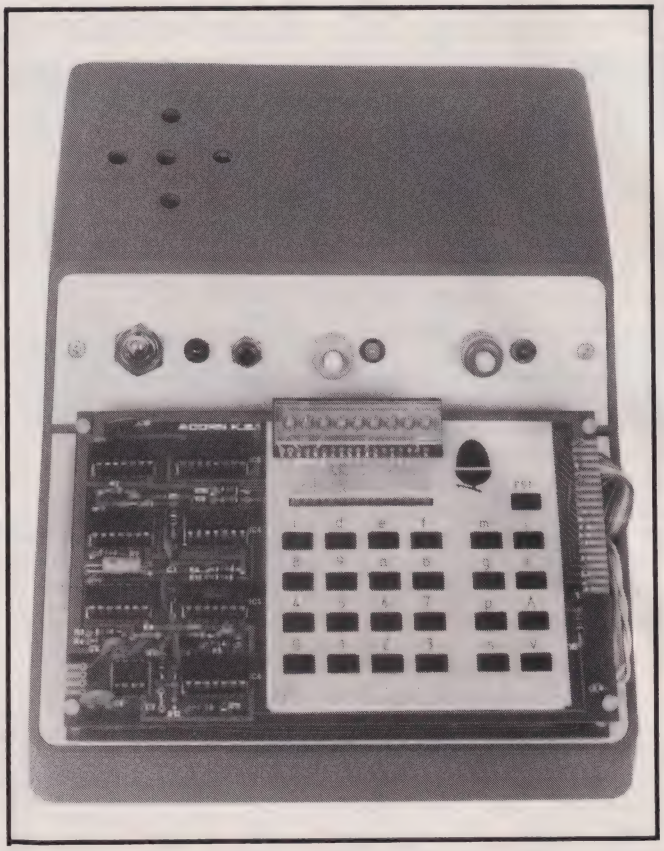
Check all inputs in this way. You may find that an error occurs in the same digit at each memory address. This indicates that the wiring of the corresponding data line is faulty.

Program B performs the same function in a Z80-based system. The same address has been used for the I/O device (0900 Hex) but this can be changed to suit the system. Whereas the 6502 reads the IRQ and NMI addresses stored in 001C/001D Hex and 001E/001F Hex and then automatically jumps to the indicated addresses, the Z80 jumps to 0038 Hex on receiving an interrupt request (INT in Z-80 code) or to 0066 Hex on receiving an NMI. The interrupt routines begin at these addresses. If you are using a Z80 system which has its monitor at these low addresses, you will probably find that these addresses hold jump instructions which take the micro out of monitor into RAM. This is where you should store the interrupt routines. For example, in the TRS-80 Model I, 0038-003A Hex store 'C3 18 64', which means 'Jump to 6418'. The interrupt routine must be POKEd into memory from 6418 onward. This can be used only for INT since the TRS-80 does not allow use of the NMI input.

Program B stores its data in the RMA of the I/O device but can be readily altered to store it at other locations. Figure 19 shows the flowcharts of Programs A and B.

Finally, wire up the latch ICs and the other output lines. If you are intending to add more ICs to the board, route the wires so they will not obstruct the positioning of the ICs and their wiring at a later date. The latches may be tested by Program C, illustrated in Fig. 20. Note that data is transferred to the latches as the enable input rises from low to high.

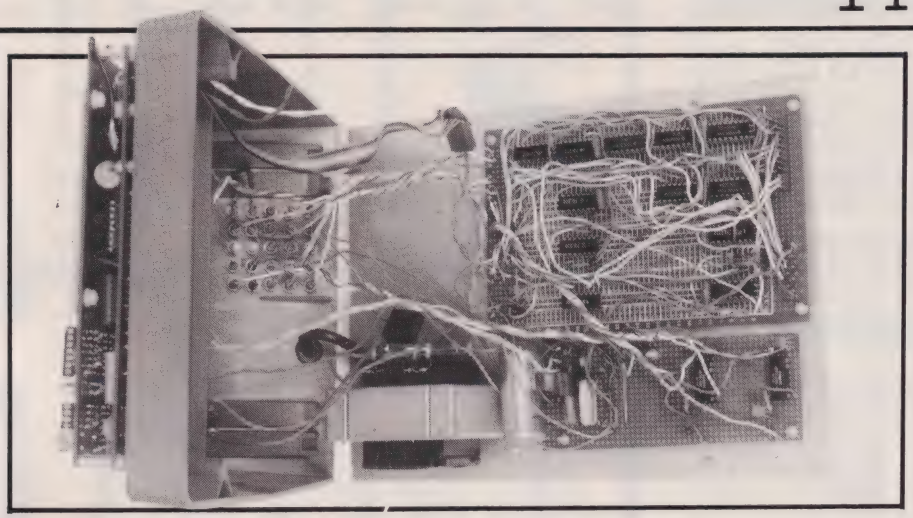
A general view of The ARGUS showing the front panel controls and the Acorn System I mounted in position.

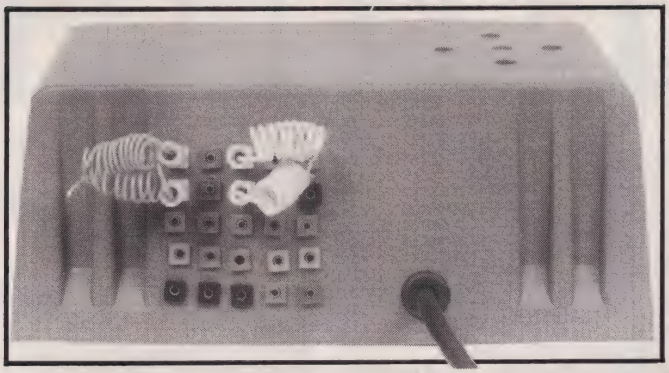


Peripherals

Connections to the Alarm Clock Timer run to the PCB plug on the clock board. In the original version the components were widely spaced out on the board. Readers may find it difficult to fit this into a case of the size recommended and those building this peripheral specially for The ARGUS system will find it easy to lay it out far more compactly, fitting it on a board about half as long and half as wide. A D-to-A interface may be stacked above the clock board.

The LEDs are mounted on the sloping panel of the case, together with the main switch, the power-up button, the 'power available' LED, and the EXIT and SECURE push-buttons (Fig. 21). Connections to other peripherals are taken to an array of 1 mm plugs on the rear side of the case (Fig. 22). Sockets are available in various colours, allowing coding according to function. The multi-tone alarm could be mounted on the case itself, though there is the disadvantage that this may help intruders to find the control panel and put the system out of commission. Probably the best





The open case reveals the internal layout of the system. This is only a prototype so no apologies are made for the hand-wiring!

The rear panel layout for the 1mm socketry. See Fig. 22 for further details.

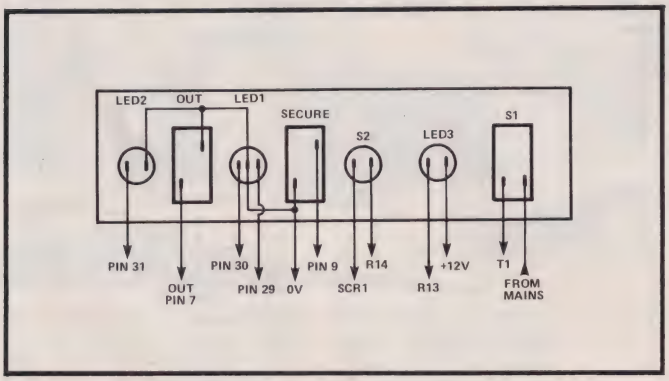


Fig. 21. The wiring layout for the rear of the switch panel. The Pin numbers are those of the lower edge of the main board, see Table 5.

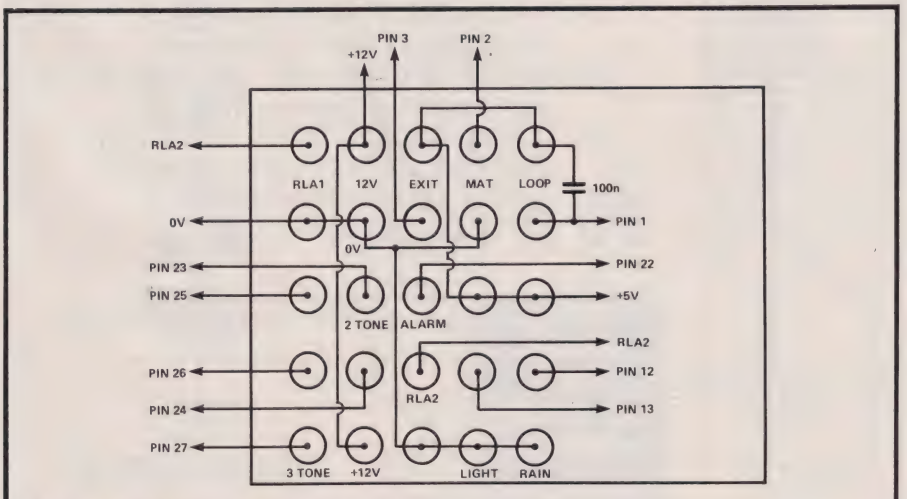


Fig. 22. Rear panel connections to The ARGUS. Once again, the Pin numbers refer to the lower edge of the main board.

course is to mount it in another room, using concealed wiring.

Security

While on the subject of system security, a few other points should be kept in mind:

1) Power supply: make sure that the plug used for supplying the system cannot accidentally be turned off;
2) If possible conceal the lead from the plug to the system;
3) Place the unit in an area of maximum security where it cannot be reached except by breaching the peripheral loop and stepping on one or more pressure mats, and where it can not be seen by persons looking in through the window. A locked, well-ventilated cupboard is probably the best idea;
4) The intruder alarm should also be in a high security location. Mount it upstairs or high on the exterior of the house;
5) Run wiring so that it is least likely to be damaged if a fire breaks out. Keep any wiring well away from open fires, boilers, cookers, etc;
6) Consider battery back-up; a single 12 V lead-acid rechargeable battery could keep the system active for several hours.

Programming For Action

The general methods for reading inputs or making outputs are illustrated by Programs A-C and Figs. 19, 20. It is important to make sure that the output definition register is changed when necessary, according to whether lines B0-B3 are to be inputs or outputs.

You will need to set aside a separate address in memory as a status register for each of the output lines E08 to E014. The low nibble of these will store the current state of each output line. For example, if the 1-tone alarm has just been switched on, but the 2-tone alarm is off and the timer reset line is low, the status register for line E09 will be 0000 0010 or 02 in Hex. If the micro then needs to switch the 2-tone alarm on as well the 1-tone alarm, it will do the following:

1) Set accumulator to code for switching on 2-tone alarm . . .0000 0100;
2) OR this with status register, giving 0000 0110;
3) Store this code in status register;
4) Put this code on data lines and latch it.

In this way the 2-tone alarm can be turned on without affecting the operation of the 1-tone alarm or any other outputs on the E09 line.

RAM Versus ROM

When The ARGUS is first put into commission you will probably prefer to type the program directly into RAM. Then it can be tested in practice. It will almost certainly need to be modified to cope with hitherto undiscovered idiosyncracies of certain members of the household.

The great drawback of holding the program in RAM is that it will sooner or later be destroyed by an interruption of the power supply. Although it is possible to keep a copy of the program on tape, it may not be convenient to load this afresh in the middle of the night.

The only answer to this problem is to put the whole program into ROM. Many systems have a socket to take an EPROM and it is not difficult to program an EPROM using one of the many designs of EPROM burner published in various magazines. Alternatively there are firms which will program one for you for a modest fee. The addressing of the micro can be altered so that the EPROM runs from address 0000 onward. As soon as the system is switched on, the micro will begin processing the program in EPROM giving you a security system which is immune from power failure.

Should your system need to be initialized by pressing the reset button, connect a 10 uF capacitor between the reset line and the 0 V line. This will hold reset low for a short period while the rest of the system acquires proper operating voltage. This has the same effect as an initial pressing of the reset button.

Once you have automatic resetting, there is no need for the 'power-up' button. S2, R2 and SCR1 of Fig. 16 can be omitted and the 12 V line taken direct to R3 and R4.

At this stage of development, you do not really need a keyboard or the display of the micro system. In the case of the Acorn System 1, you need only the controller board carrying the 6502, the INS8154 and associated components. However, it may be useful to retain the keyboard so you can have fuller control.

Beware Of Flutes!

The original Argus was a most effective watcher, but no system is unbeatable. Argus was eventually killed after Hermes had lulled all of his hundred eyes to sleep by playing a flute. The enraged Hera took the eyes and transferred them to the tail of her favourite bird, the peacock.

Don't let flutes crash your program!

```
001C 20                          NMI address
001D 02
001E 20                          IRQ address
001F 02                          (same as NMI)

                Main Program

0200 A9 F0          LDA 'F0      Define inputs
0202 8D 23 09       STA 0DB      and outputs
0205 8D 21 09       STA Port B   RESET low
0208 A9 00          LDA '00      Set it high
020A 8D 21 09       STA Port B   ready to go
020D 58             CLI          Allow for IRQ
020E 4C 0E 02       JMP to 020E  Wait on IRQ

        Interrupt Routine (NMI or IRQ)

0220 A2 07          LDX '07      Decoder line
0222 8A       A     TXA
0223 2A             ROLA         Shift code
0224 2A             ROLA         from low to
0225 2A             ROLA         high nibble
0226 2A             ROLA
0227 8D 21 09       STA Port B   Enable buffer
022A AD 21 09       LDA Port B   Read data
022D 95 20          STA Z,X      Store it
022F CA             DEX          Count down
0230 10 F0          BPL to A     Do it again
0232 4C 04 FF       JMP to Monitor
```

Program A. This routine will test The ARGUS on a 6502-based micro.

```
                Main Program

0200 A9 FF          LDA 'FF      Define Port B
0202 8D 23 09       STA 0DB      as all output
0205 A9 F0          LDA 'F0      Reset low
0207 8D 21 09       STA Port B
020A A9 00          LDA '00      Reset high
020C 8D 21 09       STA Port B
020F A5 21          LDA Z,21     Load data
0211 05 20          ORA Z,20     Load address
0213 8D 21 09       STA Port B
0216 A5 21          LDA Z,21
0218 8D 21 09       STA Port B   Latch it
021B 4C 04 FF       JMP to monitor
```

Program C. This program will test the output latches of the system when connected to a 6502-based computer. Before running the data corresponding to the output to be activated should be stored at 0021 Hex.

```
                IRQ service routine

        PIO     EQU 9000     I/O device
0038 06 07          LD B,7
003A DD 21 00 90    LD IX,PIO
003E FD 21 80 90    LD IY,PIO+128
0042 78       NEXT  LD A,B       Get number
0043 17             RLA          Shift from
0044 17             RLA          low nibble to
0045 17             RLA          high nibble
0046 17             RLA
0047 32 21 90       LD (PIO+21),A
004A DD 7E 00       LD A,(IX)    Read data
004D FD 77 00       LD (IY),A    Store it
0050 DD 23          INC IX
0052 FD 23          INC IY
0054 05             DEC B
0055 FA 42 00       JP M,NEXT
0058 ED 4D          RETI         Return

                NMI service routine

        PIO     EQU 9000     I/O device
0066 06 07          LD B,7
0068 DD 21 00 90    LD IX,PIO
006C FD 21 08 90    LD IY,PIO+136
0070 78       NEXT  LD A,B       Get number
0071 17             RLA          Shift from
0072 17             RLA          low nibble to
0073 17             RLA          high nibble
0074 17             RLA
0075 32 21 90       LD (PIO+21),A
0078 DD 7E 00       LD A,(IX)    Read data
007B FD 77 00       LD (IY),A    Store it
007E DD 23          INC IX
0080 FD 23          INC IY
0082 05             DEC B
0083 FA 70 00       JP M,NEXT
0086 ED 4D          RETI         Return

                Main input routine

        PIO     EQU 9000     I/O device
        START   IM 1
0200 ED 56          LD A,0F0     Define I/O
0202 3E F0          LD (PIO+23),A
0204 32 23 90       LD (PIO+21),A
0207 32 21 90       LD A,00
020A 3E 00          LD (PIO+21),A
020C 32 21 90       JP WAIT      Wait for IRQ
020F C3 0F 02       JP START
0212 C3 00 02
```

Program B. As Program A but for a Z80-based computer.

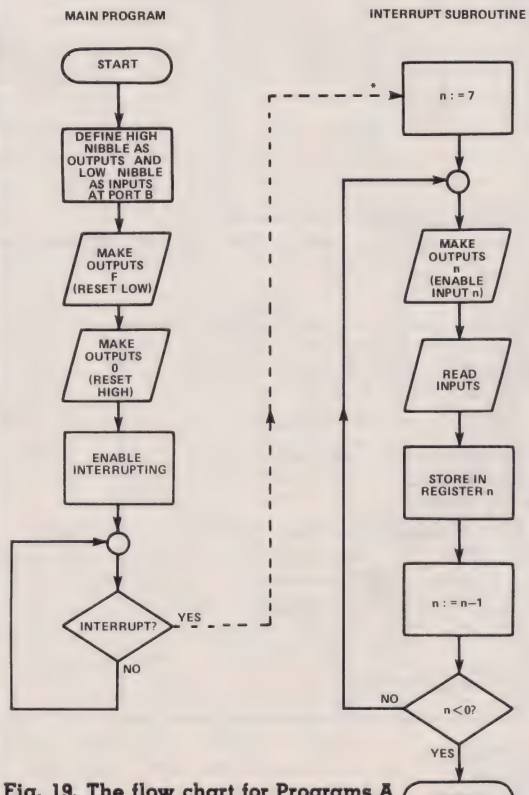


Fig. 19. The flow chart for Programs A and B.

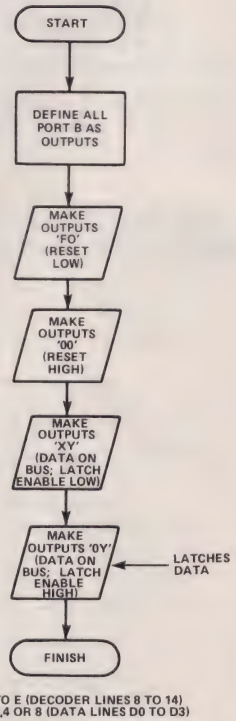
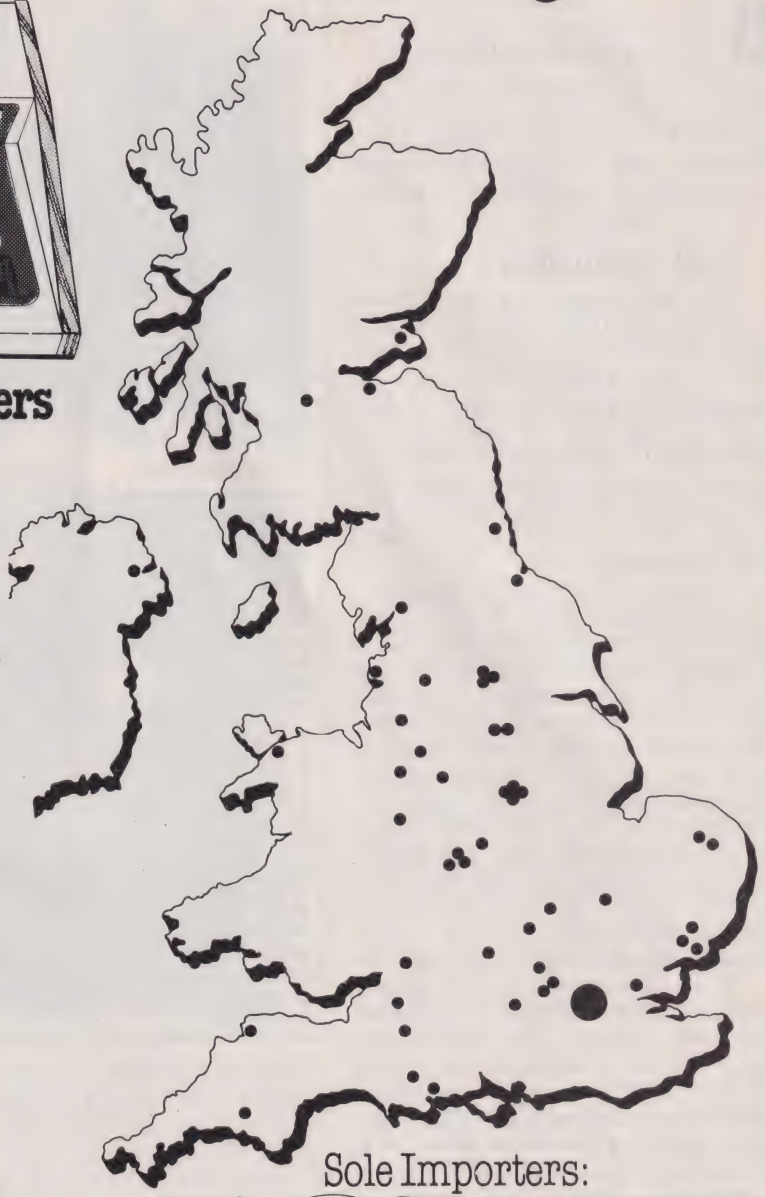


Fig. 20. As Fig. 19 but for Program C.

Wherever you are in the UK there's a Genie dealer nearby



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Henry Budgett

With the BBC's Computer Literacy project now well under way, the next steps are already being planned. Will there be a second series? What is happening about the supplies of the BBC Micro? When will the Telesoftware appear? For answers to these and other burning questions, read on!

By now, I hope, many of you will have seen the majority of programmes in the BBC's Computer Programme series. I felt that it would be interesting to do a follow-up to the article I presented in the February issue which listed the aims and programme content of the series — a sort of aprés vu!

Post Production

The real question as to whether the series has suceeded as both a piece of television *and* as an educational programme will not be answered for some time yet. A full audience research project will be getting under way soon to evaluate the series but we already know that the only real criticisms levelled so far are those concerning the very poor scheduling.

The producer, Paul Kriwaczek, certainly seems to feel that the programmes have achieved their brief of introducing computers to the public. In conversation he agreed that "We'd won some and lost some" but, as always, that is the nature of television. Paul will not be involved with either of the two coming series, he's currently committed to writing a book on computer music (a sort of busman's holiday) and will then produce a series on bio-technology followed immediately by one on the intimate details of an orchestra.

Considering the incredible period of time over which the series has been created (we first heard about it at a launch of Clive Sinclair's ZX80), the end result probably represents the best part of two years worth of dedicated effort — a tribute to the endurance of the team that made it!

The Second Programme

By this time next year, if all goes according to plan, the second series of The Computer Programme should be transmitted. The producer, David Allen, is still currently working in his role as Project Editor for the first series — a job which has involved editing the Computer Book and preparing both versions of the manual as well as getting the BBC Software packages prepared.

Above: That arm seemed to have a mind of its own at times. Here it appears to be threatening the producer, Paul Kriwaczek, while software supremo Ian Trackman regards it with distain!

Right: Co-presenters Chris Serle and Ian McNaught Davis take a well-earned break on an array of micro hardware.

Although the content of the second series is by no means finalised it is more than likely that it will be aimed more at the micro user than at a general audience. In much the same way as the first series set out to demonstrate an area of application per programme, the second series looks set to pick a specific principle of operation in each programme. It is unlikely, in my view at least, that the series will try to teach programming; it may well link up with the excellent NEC course in places but 25 minutes of solid programming tutorial is about as interesting as watching paint drying... this is, after all, a television programme and they are meant to be 'entertaining' in the general sense of the word.

Just who will be taking part in the making and presenting of the series is, as yet, undecided but hopefully some of the names you have become familiar with will be involved.

Classroom Computing

The second of the two series to be made during this year will be a follow-up to the pair of programmes entitled 'Micros in the Classroom'. Produced by Mike Garrod, possibly better known for his series on Industrial Archaeology; it has a wide ranging brief to cover virtually any and every aspect of its title.

Left: Ian (I'd rather be on top of Ben Nevis) McNaught Davis is currently doing a short series for the DOI on Information Technology... not for public consumption I'm led to understand.

Below: The making of the series part two. In fact it took more time than one would care to admit to film that sequence with the robot arm feeding those goldfish!

The Open University is currently running a Continuing Education Project in this area and it is hoped that the two sets of programmes will, in some way, interlink. The OU package will probably consist of three programmes with the usual volumes of material and is aimed at the teacher who wishes to make use of computer technology in the classroom. The BBC series is more likely to be aimed at the teacher interested in seeing what is available and how it is being used.

I must confess that my views on the use of micros in the classroom are somewhat akin to my views on the American re-armament programme — you can't always solve the problems by simply throwing money at them! However, in common with the problems currently faced by the educationalists, the real issues are much simpler — how to educate the teachers to a point where they can educate the students! All the arguments about teaching this language or that language are completely academic, what the teacher really needs is something that can be used to teach with... computer ***aided*** learning in its truest sense.

In many ways this, to me, is the most interesting of the two projects, simply because it is something that I have strong views on. Without doubt there will be micros in most classrooms before the end of the decade, the problems of how to use them to the best advantage for both teacher and pupil are only just beginning to emerge. The findings of both this series and the OU project could well have a stong influence on the way that the educationalists tackle these problems — they themselves still seem unsure of which way to turn.

Speaking Softly

The flow of 'software' for the BBC system is rapidly increasing from a trickle to a deluge. Under the Editorshop of David Allen, together with the assitance of a team of software testers, the first launch of BBC-created packages is currently scheduled for late April or early May. Among those destined to appear are the Consumer's Association Home Finance package consisting of four programs; some games programs which will be marketed as 'Fun and Educational'; a music package; a graphics package plus several other packages aimed at the educational market.

All of these introductory packages are for the Model A system, the next batch will incorporate programs using the advanced features of the Model B. Among those already in the pipeline are a word processor, an astronomy package and several business oriented programs.

To encourage potential authors to meet the BBC's extremely high standards, a set of software guidelines are being published and these will shortly become available.

The use of the telesoftware medium is also to be expanded with more programs being put on-air. The standard currently selected for this service is based on that developed by the Council for Educational Technology although some slight modifications have been made to the original specification. All the programs will be transmitted in encoded form, notes will be given on how to make use of them if you don't have a Teletext receiver.

The other 'soft' products being produced include the BBC's Computer Book which will be reviewed in our next issue, the NEC course in BASIC programming and the second volume of the User Guide. The first two have achieved exceptional sales already; both the standard and the special ZX81 version of the BASIC course seem to be going down very well indeed.

The second version of the User Guide is currently well under way, it will probably stretch to some 500 pages by the time it is printed and is an amazing document. All the basic information contained in the first Guide will be used as a 'short-form' introduction to the BASIC. This will then be followed by what can only be described as copious notes on virtually every single command and function,together with details of the operating system, sample programs and more besides.

Of course, the BBC aren't the only people producing material relating to the programmes and the computer. Several other publishing houses and a whole host of software companies are all beavering away to produce competing products. Indeed, a glance through the pages of this, or any other, magazine will reveal the extent to which the market has already developed. We will, hopefully, be able to review and report on the various offerings as and when they become available.

The Hard Option

Numerous enquiries have been received concerning the steadily slipping delivery dates for the BBC Micro and so it seems that this is as good a place as any to set the record straight. The sole problem was with the ***production*** versions of the video ULA; it had worked perfectly in prototype form. This has now been cleared up and the manufacture of these devices is now going smoothly.

However, the delays have, obviously, meant a slipping of the schedules for completed units and the current rates are some 1,000 plus per week. This is less than half of the envisaged target for this date based on the old schedules,but ICL and Cleartone are being moved into full production of some 10,000 units per month as fast as is humanly possible.

The other interesting problem posed by the advance publicity was the fact that the bulk of the orders, over 68% apparently, were for the Model B. This went against all expectations and caused one or two minor headaches over chip supplies. However, as the ULA was delayed, the breathing space generated has allowed the chip stocks to be built up so no problems should occur there.

Adding On

The provision of extras for the BBC system is well advanced and the timetable for deliveries goes something like this:

Discs	Interface by April, drives by May. CP/M to come when second processor ready.
Teletext	Ready by June, approx £150.
Prestel	Ready by July, approx £150 but both together will be less than £300.
Econet	Ready by May-June.
Second CPU	Z80 and 6502 options by July-August. 16-bit processor in the Autumn.

These dates can be taken as ballpark figures, I certainly wouldn't like to bet money on them! There is, however, one rather interesting point to note in this timetable. If Acorn manage to produce the DOS and the corresponding single and double drives before October this year, they will have beaten the development timescale of all previously launched British personal computers. Considering the somewhat shaky start caused by the ULA disaster that still represents a very creditable achievement.

And End... Of Sorts

The beauty of the BBC's Computer Literacy project is that it is unlikely to ever end, unless the cuts really bite deep. It's going to become one of those institutions which are doomed to live on forever in one form or another... a sort of televised Flying Dutchman. This is not meant to decry the project, far from it. We will one day, I hope, look back and say that this was the first real attempt to introduce microcomputers to the general public. All right, so it may have been a year late and it may well have been transmitted at some of the most unwatchable times ever scheduled... but it certainly did what it set out to do.

The viewing audience is currently understood to have been about 300,000 per programme and if that seems somewhat small it should be realised that it represents about 70% of the available audience at those particular ***transmission*** times and not of the total possible television audience.

The response generated by that audience has been huge, the Referal Service has been receiving some 1000 enquiries per day of which some 160-170 have been requests for details of local clubs and user groups. Bob Salkeld, the Project Education Officer for the series, commented that the series certainly seems to have whetted the appetites of the viewers. What they want now is the viewer's reactions and they have asked that anyone with a comment to make should address it to him through Broadcasting Support Services, PO Box 7, London W3 6XJ or you can send them in to us and we'll pass them on. Any feedback you can give will be used for both the audience research project and as a guide to the content of any future programmes.

.STOP PRESS.STOP PRESS.

The photograph above was taken on location by our enterprising camera man. The scene shows Chris Serle talking to a somewhat mysterious character about the possibilities of stealing information from computers over the telephone network. The programme this was filmed for will appear, we hope, as part of a new BBC series called QED. Watch your screens during late April, early May as it should be quite amusing....

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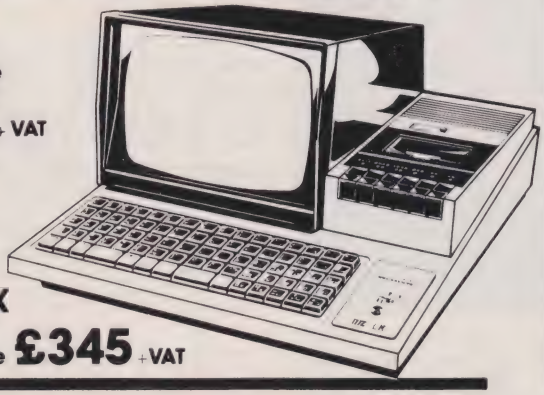

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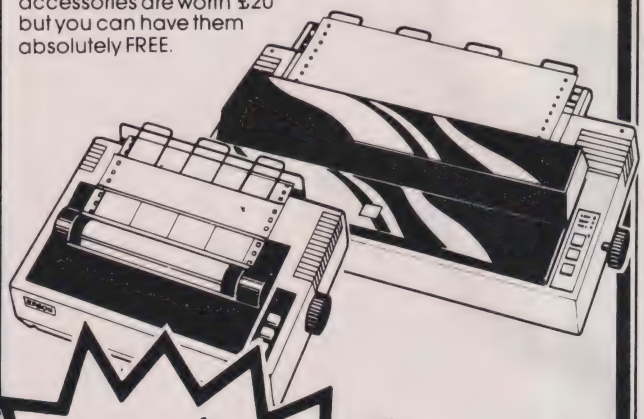

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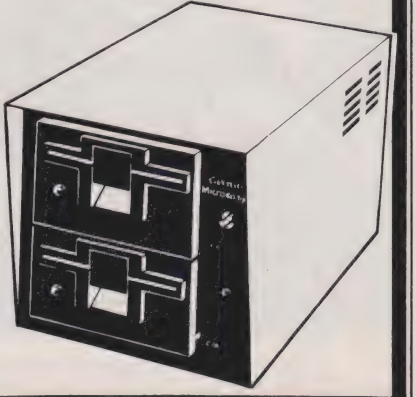

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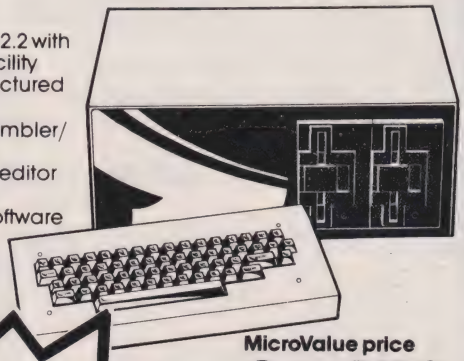

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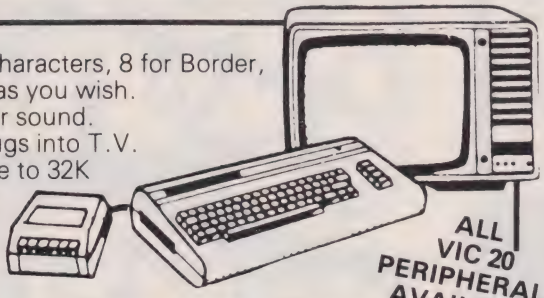

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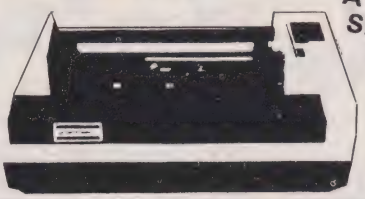

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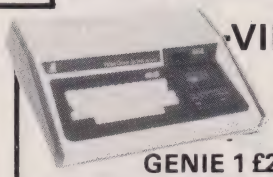

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PROGRAMMING LANGUAGES

Dr G J Marshall

We take a look at A Programming Language, the APL of Iverson's eye!

APL was invented by Kenneth Iverson and described in his book **A Programming Language** published by Wiley in 1962. The acronym APL comes from the title of the book. Iverson's original motivation for inventing APL was not so much to provide a programming language as to devise a notation in which algorithms could be expressed precisely and also one in which the behaviour of hardware could be precisely described. APL has been used successfully to describe computer hardware in a formal way and to describe the semantics of programming languages. The semantics of a computer language refer to the meaning of its instructions and APL provides a notation in which the effect of the instructions of a programming language can be described exactly. Because of its use for purposes such as these, it has been argued that APL is a system of ***notation*** rather than a programming language. However, APL is undoubtedly a programming language as well: it has been implemented for many machines and has found favour among programmers for applications in many problem areas. It was first implemented by IBM in a version known as APL/360 in the mid 1960s and it was made generally available before the end of the 1960s. Other implementations have followed since then, including some for microcomputers.

Some Characteristics

As a programming language, APL is intended for describing data processing procedures and can deal with either numerical or textual information. Using APL, it is also very simple to handle arrays such as vectors or matrices: the ability to deal with an array as a single item has led to the adoption of the language for purposes such as business planning, management and engineering design. Additionally, APL has been designed to be interactive in the sense that it is intended to be used by a programmer developing, testing and modifying programs at the keyboard. The user is encouraged to try out ideas and errors are treated in a friendly and helpful fashion. In this way, APL encourages the programming of the 'what if?' kind of applications that help a manager, planner or designer to come to a decision. In the same way as VisiCalc can be used to help in decision making, the APL user can program his own investigative test cases.

The fact that APL can handle an array as a single item also contributes to another characteristic of the language: programs written in it tend to be short. Even for quite complex computations, the programs are usually concise. This conciseness can be seen both as an advantage and as a drawback. With concise programs, it is usually relatively simple to determine the structure of a program: also, in general, it requires less time to develop a program. The main drawback, however, is that it is harder to understand and therefore to modify concise programs. Since anyone demonstrating the use of APL is naturally anxious to display the power of the language and, perhaps, their own virtuosity, the tendency is to demonstrate programs which are short and powerful, but hard to understand. This can be counter-productive, since it is liable to convey the impression that APL is difficult to understand. In fact, I would say that although APL ***is*** different it ***is not*** difficult (no more so than any other language of comparable power, anyway). It has been remarked of other programming languages featured in this series that there is a trade-off between the conciseness and the readability of the programs written in them. APL, in particular, lends itself to extremely clever tricks, with whose aid a computation can be described extremely briefly. In a program intended for use by no-one except the originator, this is admirable but if anyone else is to use the program, and particularly if they may need to modify it, then it is surely more important that the program should be readable rather than concise. In any event, APL programs need to be well-documented.

It is characteristic of APL that it relies heavily on operators; this has many consequences, a few of which will be mentioned as they relate to points made already. First, the operators contribute towards making programs short because a particular problem is programmed by employing the operator that is most suitable. Secondly, APL can be learnt part by part because only the small piece of it actually needed for a particular application, including the necessary operators, need be understood. It is possible to learn the language in small pieces because each part is independent of all the others. Most programming languages do not possess this kind of independence. Thirdly, because it possesses a large number of operators, APL has a special character set so that most of the operators can be represented by a single special character. This means that APL programs appear very strange to those unfamiliar with the language. It also means that a special input device giving the special characters is needed. Actually, it is not absolutely essential to have an APL keyboard because there are 'ASCII equivalents' to every APL character, so that APL programs ***can*** be entered from a standard keyboard. However, since the APL notation is so much a part of APL itself, any serious APL user must come to think in terms of the APL notation and would surely find the interactive use of the language severely handicapped by the absence of the appropriate keyboard.

The Language And Some Programs

The character set which gives the APL notation consists of the letters, numbers and the special characters shown in Fig. 1. Most of the special symbols are used to represent the operators of APL.

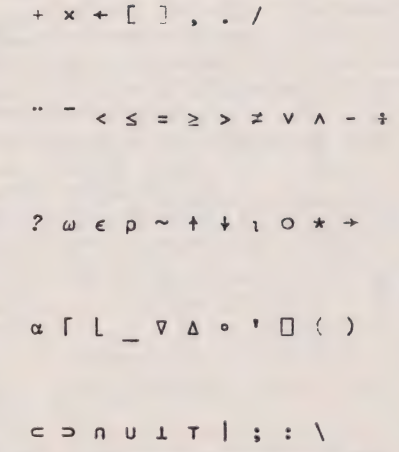


Fig. 1. Characters representing APL operators.

```
      4+2
6
      4-2
2
      4×2
8
      4÷2
2
      4*2
16
      4⌊2
2
      4⌈2
4
      4×2+3
20
      4÷5-3
2
      (4+3+2)/3
3
      X←12
      X
12
```

Fig. 2. Dialogue with APL.

Figure 2 gives a short dialogue with APL and is intended to illustrate the use of the operators as well as the interactive nature of the language. When APL is ready to accept information from the keyboard, it outputs six spaces. A line is then entered by typing it out and pressing RETURN. APL's response is then given on the next line starting from the left margin. Thus, in Fig. 2, alternate lines show the use of the arithmetic operators: when an expression involving an operator is entered, APL evaluates the expression and returns its value. The asterisk in the fifth entry denotes exponentiation, or 'raising to the power'. The operator in the following entry is the 'minimum' operator, which returns the smaller of its arguments, while the entry after that contains the 'maximum' operator. The eighth and ninth entries illustrate that APL always tackles expressions from right to left, so that 4 x 2 + 3 is evaluated by doing the addition first and then the multiplication. This is confusing to anyone familiar with BASIC or FORTRAN, where the correct priority is automatically assigned to arithmetic operators and it may well appal anyone who has mastered Reverse Polish Notation in order to use his Hewlett Packard calculator! The next entry shows that brackets can be used as required in expressions. The left-pointing arrow in the following entry indicates an assignment. After a value has been assigned to a variable, the value can be obtained simply by typing the name of the variable. APL signals an error if one attempts to find the value stored in a variable before any assignment has been made to that variable.

Figure 3 shows the simple and consistent way in which APL deals with lists or vectors. A list of numbers is a set of numbers each separated by one or more spaces. The first entry shown in Fig. 3 causes 2 to be added to each item in the following list, while the second causes each item to be multiplied by 4. In the next entry the corresponding items of two lists of the same length are added, while in the following entry the maximum of each corresponding pair is found. Assigning a list to a variable is achieved in the same way as a single value is assigned. Typing the name of the variable then gives the list.

```
      2+1 7 9 5
3 9 11 7
      4×1 7 9 5
4 28 36 20
      1 7 9 5+4 5 3 2
5 12 12 7
      1 7 9 5⌈4 5 3 2
4 7 9 5
      X←1 7 9 5
      X
1 7 9 5
      ρX
4
      +/X
22
```

Fig. 3. Dialogue involving lists.

The operator in the next entry causes APL to return the number of items in the list assigned to X. The last entry illustrates what is known as 'reduction' in APL. The effect is that the operator preceding the slash is applied to all the items in the succeeding list: the result obtained is the same as if the operator were placed between all the items of the list.

Characters can be handled in exactly the same fashion as numbers. A dialogue illustrating the use of some of the APL operators for handling characters is shown in Fig. 4. The entries show two assignments of character strings to variables and then the use of the operators for concatenation, finding the length of a string and finally two examples each of the operators for 'taking' and 'dropping'. The facilities illustrated are equivalent to those possessed by BASIC in the functions, LEN, LEFT$ and RIGHT$.

```
      S←'SKY'
      T←'TRAIN'
      S,T
SKYTRAIN
      ρS
3
      2↑S
SK
      -4↑T
RAIN
      1↓T
RAIN
      3↓T
IN
```

Fig. 4. Dialogue involving character manipulation.

Figure 5 shows an APL 'one-liner', which is displayed alongside the more-or-less equivalent BASIC program, to illustrate the compactness of the APL version. The programs accept and store a list of numbers and then find their average and print it out. The only unexplained symbol in the APL program is the square and this causes APL to accept the input typed at the keyboard until RETURN is pressed. A list of numbers is entered by typing the numbers separated by one or more spaces and pressing RETURN after the last number.

```
10 INPUT N
20 DIM V(N)
30 FOR I = 1 TO N
40 INPUT V(I)
50 NEXT I
60 S = 0
70 FOR I = 1 TO N
80 S = S + V(I)
90 NEXT I
100 PRINT S/N
110 END
```

```
(+/V)÷ρV←□
```

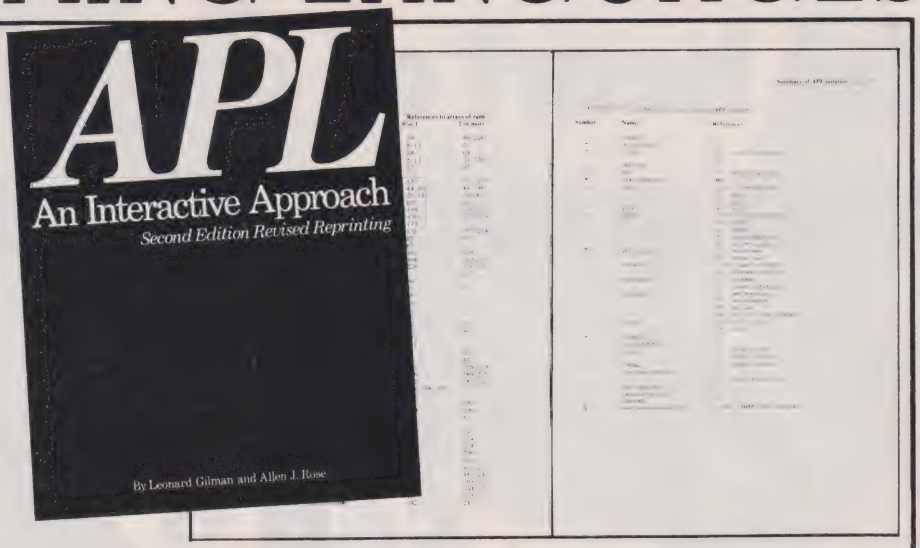
Fig. 5. APL one-liner and its equivalent BASIC program.

PROGRAMMING LANGUAGES

Summary And Further Reading

APL is an extremely distinctive high-level language, mainly because of its consistent use of operators. Since it possesses a wide range of operators, it has no need of the constructs supplied by languages such as Pascal and BASIC for purposes such as repetition and executing commands only under certain conditions. The distinctiveness of APL often requires a different approach to tackling problems. A change of approach to problem solving may not always be welcomed by those who have to change, but the rewards can include improved solution methods and even solutions to previously intractable problems.

APL has proved itself a useful and versatile computer language. Hopefully, the example programs presented above have indicated that with its aid, computations can be described with extreme brevity. While this can lead to APL programs that are hopelessly difficult to understand, Iverson himself has asserted that it is possible to make APL programs at least as readable as those written in any other language by avoiding complex single lines and by providing proper documentation.



The community of APL users is expanding rapidly now that versions of the language are available for microcomputers. There are several implementations available for Z80-based micros, including APL/V80 from Vanguard Corporation. A purpose-designed micro-APL system called MAPLE is available from A P Ltd.

The best book that I have found to provide an introduction to APL is **APL/ 360: an interactive approach**, by L Gilman and A J Rose (Wiley, 1970). Although its explanations refer to the use of the IBM implementation of APL from an APL terminal, it introduces and explains the features of the language in a clear and logical way. It also illustrates the language's capabilities very nicely.

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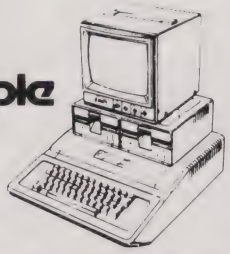

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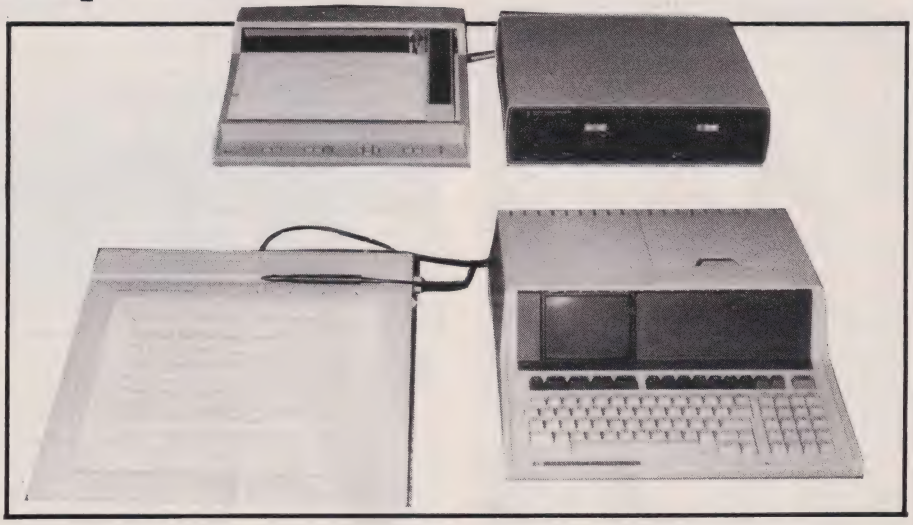
TIPPING THE BALANCE?

Dr G J Marshall

Dedicated desktop systems based around microprocessor technology are becoming more and more common. The question is, 'can they provide the facilities you are used to?'. As this report suggests, the answer may not be the one you might have expected.

The Hewlett-Packard personal computer has already been reviewed at length in this magazine. Now a range of peripherals is available for this micro allowing it to be transformed into a very powerful interactive graphics system. The system, illustrated opposite, basically consists of the HP-83 personal computer, a disc unit, graph plotter and digitising tablet. Table 1 gives a complete list of all the hardware involved.



HP-83	Personal computer
HP-7225A	Graph plotter
HP-82901M	Double disc drive with disc controller
HP-9111A	Graphics tablet
HP-82937A	HP-IB interface
HP-10833A	Interface extensions
HP-82936A	ROM drawer with plotter/printer ROM and Mass Storage ROM installed
HP-82903A	16K memory module

Table 1. The equipment comprising the HP graphics system.

This article tries to give an account of the capabilities of HP's graphics system and to illustrate ways in which it can be used. I have refrained from calling this a review because to give a full review of the system would require something nearer to a book that an article. However, the aim of the article is to show that this system, which costs approximately £7,000, is quite as powerful as much more expensive systems based on mini and even mainframe computers. Of course, the graph plotter and graphics tablet could be attached to a mini or a mainframe, so in this sense it is clear that this micro-based system has peripherals and capabilities equal to those of any other system. I can vouch that it has the capability to do everything I can do with a (more or less) £1 million mainframe; all it is lacking is the quantity and variety of graphics software that has been developed for large machines over the years. However, this lack is counter-balanced by the comparative ease with which the micro-based system can be used.

At the same time as obtaining the system, one acquires a stack of manuals, as it admits somewhere in one of them, about six feet high.

The task of ploughing through all this information and instruction is rather daunting, but it is clearly the only way in which the user can appreciate and then harness the system's tremendous potential. Much of the reading is not as heavy as might at first be feared because there is much familiar territory. Presumably every user will be familiar with using a small computer, and many with graphics peripherals, so that the manuals for these can be read simply as conversions to Hewlett-Packard's way of doing things. Needless to say, the quality of all the manuals is very good.

Rather than plunging in with an attempt to examine the complete system, we will start with the computer itself and, after examining its graphics capabilities, explore the potential of the increasingly sophisticated systems obtained by attaching more and more peripheral hardware to it.

The Heart Of The System

The computer this system is based on is a Hewlett-Packard HP-83. Apart from not having a built-in printer and tape cartridge drive, this machine is identical to the HP-85 which was previewed and then reviewed in Computing Today, April 1980 pages 31-33 and June 1980 pages 50-54. As explained in these articles, the computer possesses an Extended BASIC which includes a range of graphics commands. These commands and their meanings are listed in Table 2. They can be used in the first instance to produce displays on the HP-83's built-in screen, which has a resolution of 256 horizontally by 192 vertically. To illustrate a fairly typical small program and the display it can produce, the following program generated a graph displaying two cycles of a damped sine wave on appropriately labelled axes as shown in Fig. 1.

```
 10  GCLEAR
 20  SCALE -PI/2,4*PI,-1,1
 30  XAXIS 0,PI/2,0,4*PI
 40  YAXIS 0,0.5
 50  MOVE 3*PI,-0.2
 60  LABEL "TIME"
 70  MOVE PI,0.8
 80  LABEL "DAMPED SINE WAVE"
 90  MOVE -PI/4,-0.2
100  LDIR PI/2
110  LABEL "VOLTAGE"
120  S=4*PI/255
130  FOR X=0 TO 4*PI STEP S
140  PLOT X,SIN(X)*EXP(-X/4)
150  NEXT X
160  END
```

Reference to the above and to Table 2 should make clear the function of each line in the program. The SCALE command in line 20 makes the graphics display particularly convenient and easy to manage because there is not the need to worry about manipulating actual

screen positions as there is with most micros possessing high-resolution facilities. It is only necessary to present the values to be plotted and the system will automatically position them on the screen.

Plotting To Print?

The HP-7225A graph plotter is a small flat-bed plotter with an A4 sized plotting area. It is a neat and compact device. When first plugged in, without being attached to the computer, it performs several initialisation procedures, one of which causes the pen holder to be positioned at the top right of the plotting area with a slightly alarming juddering. However, the plotter has a built-in confidence test which at the press of a button causes a particular fan-shaped pattern to be drawn, thus confirming the plotter is operating satisfactorily and, incidentally, allaying any fears aroused by the juddering.

The plotter is connected to the computer using a Hewlett-Packard Interface Bus (HP-IB). In order to communicate easily with the plotter, it is necessary to install a special plotter/printer ROM in the computer. This ROM is installed in a special ROM drawer fitting in any one of the slots in the rear of the HP-83.

When the system is set up in this way it is possible to use the plotter in various ways. The most simple and direct way permits displays developed on the CRT to be drawn unchanged on the plotter. To do this, with the program producing the required screen display stored in the machine, it is only necessary to issue the command:

```
TRANSLATE
```

which translates the program to a form suitable for the plotter/printer ROM to communicate to the graph plotter. Then the command:

```
PLOTTER IS 705
```

identifies the plotter as the target device. The codes 7 and 5 are set in hardware by switches on the plotter and the interface. Now running the program — simply by pressing the RUN key — causes the plot to be drawn by the graph plotter. It is positioned on the A4 plotting area in precisely the same way as the original display was situated on the screen.

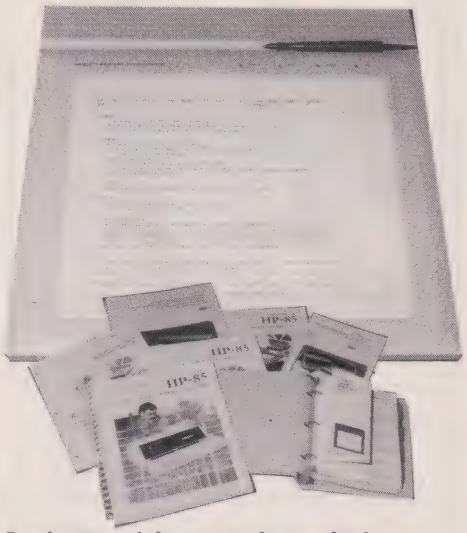
Obviously, the plotter should be prepared before it is used to draw anything. All that is necessary for this is to install a pen in the pen holder and to press the CHART LOAD button on the front panel of the plotter. Then the plotting paper is placed on the platter and the CHART LOAD button is pressed again to activate the electrostatic charge that holds the paper down.

The plotter/printer ROM makes it possible to write programs which can control the plotter directly without any need to use the TRANSLATE command. It also provides a high-level graphics programming language called AGL (A Graphics Language). Besides the commands that can be used for screen graphics, this language possesses a great many others; most of these extra commands and their meanings are given in Table 3 although some of the more esoteric commands are not listed. Fig. 2 was generated by the following program and is intended to give some idea of the power of AGL.

```
 10  DIM L$[25]
 20  PLOTTER IS 705
 30  SHOW -1.5,1.5,-1.5,1.5
 40  MOVE 1,0
 50  FOR A=0 TO 2*PI STEP 2*PI/360
 60  DRAW COS(A),SIN(A)
 70  NEXT A
 80  MOVE 0,0 @ DRAW 1,0
 90  X=0
100  LORG 2
110  FOR I=1 TO 7
120  READ P,L$
130  P2=P/100 @ X=X+P2
140  D=X*2*PI
150  MOVE COS(D),SIN(D) @ DRAW 0,0
160  Y=(X-P2/2)*2*PI
170  LDIR Y
180  LABEL USING "5X,K,4A,DD,A";L$,
     " -- ",P,"%"
190  NEXT I
200  DATA 17,"Mathematics",
     10,"Chemistry"
210  DATA 11,"Physics",
     19,"Electronics"
220  DATA 23,"Computing",
     12,"Biology"
230  DATA 8,"Food Science"
240  LDIR 0
250  MOVE -0.8,1.25
260  CSIZE 6,0.5,0.25
270  LABEL "Analysis of Library
     Books"
280  MOVE -0.9,-1.25
290  LABEL "Total Number of Books --
     5 012"
300  END
```

Above: Using the graphics tablet and stylus to input a shape to the HP-83.

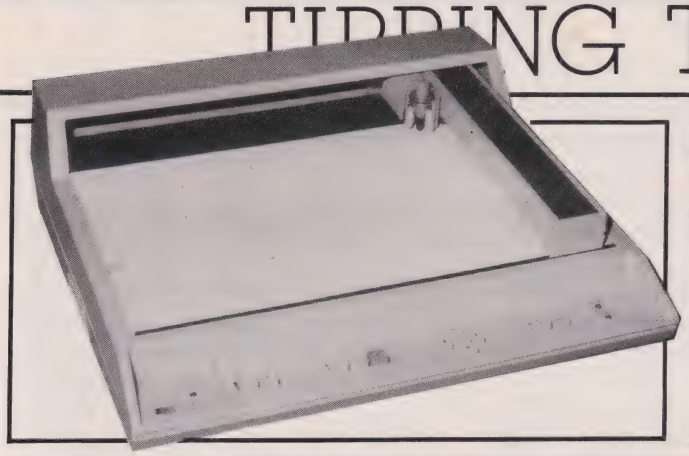
Below: The graphics tablet in close-up revealing the various softkeys at the top.



A selection of the manuals supplied, somewhat heavy reading!

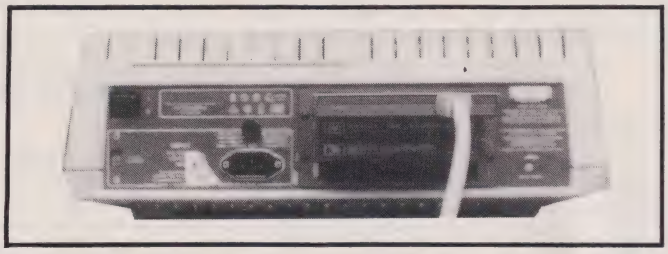
This illustration should make it clear that the graphics language provided by the plotter/printer ROM not only makes it very easy to use the plotter but also provides users with a powerful and flexible means of generating their plots. Since the HP System is aimed more directly at users in scientific and engineering research and development the facilities are particularly designed for the generation of graphs and charts. However, once the graphics language has been mastered, plots of any kind can be produced.

The plotter can also be used as a digitiser by positioning the pen using the movement control buttons on the front panel of the plotter and then entering the point using the ENTER button. This way of using the plotter will not be described further



Left: The plotter can be used under high level language control or via a special ROM containing HPGL.

Right: The rear of the HP-83 with the HP-IB interface and the ROM drawer installed.



since there is a special purpose digitiser which is much more powerful and easier to use.

There is a third way to control the plotter involving the use of the Hewlett-Packard Graphics Language (HPGL); an assembly code graphics language as opposed to the high-level one provided by AGL. HPGL can be used to write efficient graphics programs, but, in the first instance at least, it is most likely to be used for selecting an alternative character set or changing the plotting speed of the pen. These facilities are not available from AGL.

Saving The Day

The HP-82901M flexible disc unit contains two disc drives and a disc controller. It is used in conjunction with a Mass Storage ROM installed in the ROM drawer of the HP-83 providing all the capabilities required to use the disc drive effectively. The disc unit itself is uncluttered, even streamlined, and is functional to a degree. The Mass Storage ROM provides the commands for operating the disc unit, giving all the facilities one would expect, and some others besides. I found that the manuals for the disc drive were not as well presented as the others, being rather heavily inclined to jargon in places and sometimes none too clear. However, the manuals contain all the information necessary to be able to operate the disc unit and it is undoubtedly true that once the operating commands are mastered, the unit is easy to operate and very robust in operation.

When dealing with a disc that is already initialised, simply place the disc in, say, drive 0, and give the command:

```
MASS STORAGE IS ":D700"
```

which establishes the default storage device as the unit specified by D700 (the code for drive 0 of the disc unit). A program can then be loaded from the disc by:

```
LOAD "Filename"
```

and the program currently in the computer can be saved by:

```
STORE "Filename"
```

The file directory is obtained by typing:

```
CAT
```

These few examples should make clear that the disc unit is operated in a way entirely familiar to anyone who has used a disc unit of some kind before.

Wax Or Stone?

The graphics tablet is compact, functional and easy to use. Basically a platform for the digitising surface, the unit has a stylus made deliberately in the form of a user-friendly ball-point pen. The area of the digitising surface is 30 cm by 22 cm, and along its top it has 16 special small rectangular areas, referred to as 'softkeys', used to select items from a menu of functions. The tablet operates under program control; the operating program must be written in HPGL.

The extensive documentation for the tablet includes a tutorial section describing various applications and programming examples. Unfortunately, a further ROM (an input/output ROM) is needed to support the commands described in the illustrations in the tutorial section. The methods described in the manual are not only ones that can be used but they do minimise the dependence of programs written for the tablet in HPGL. Since using the input/output ROM would mean acquiring another pile of manuals, I decided to concentrate on using the tablet with the software provided for it. I justify this by pleading that only in a research laboratory would one begin by developing one's own programs for the digitiser. A graphic designer or an architect using the tablet would expect to be able to use it at once using software supplied with it.

In fact, the quality of the software supplied is very high. The disc provided contains a suite of programs, and running the first program on the disc causes a menu to be displayed on the HP-83's screen as well as generating a cross-shaped cursor. On the screen, the cursor follows the movement of the stylus across the surface of the digitising tablet. A program is selected from those on offer by positioning the cursor in the box containing its name and pressing the stylus down so that it digitises. Pressing the stylus down causes an audible click that can be both felt and heard. The selected program is then loaded and run.

The most useful programs in the suite are two drawing programs. The others are designed as much to show off the tablet's capabilities as to be useful tools. Each program is provided with a transparent overlay which when placed over the digitising surface of the tablet gives instructions on how to use the program and identifies the function of each softkey within the program. The Continuous Drawing program permits figures to be traced and sketched. Activating the appropriate softkey and positioning the stylus on the shape to be traced, the stylus is pressed down causing the shape to be reproduced on the display screen as the stylus traces along it. Other, unconnected contours can be added in a similar way.

The program also provides facilities for erasing part of a picture, selecting different time types such as dashed rather than continuous lines and storing completed pictures. These facilities and others are all obtained by activating the appropriate softkey. The picture above shows the tablet being used in this way with the overlay in position on the tablet and part of the tracing displayed on the screen.

A second drawing program permits drawings of the kind a circuit designer or an architect might wish to use. It has a facility for drawing a line by indicating its two end points; rectangles can be drawn by indicating two opposite corners; and a polygon can be constructed simply by indicating the centre and a point on the polygon itself. There are also facilities for zooming in on a particular region of the picture or for panning across it and erasing elements of a picture. The second drawing program also provides, through the selection of the appropriate softkey, the facility to produce the picture developed on the graphics plotter (Fig. 3 shows a plot obtained in this way). Note that the drawing itself consists of a small number of lines, rectangles and polygons.

Conclusions

The peripherals Hewlett-Packard now provide for their HP-83 and HP-85 computers include graphics peripherals allowing a fully interactive graphics system to be configured. The graphics tablet and plotter, which respectively permit graphical input and output, are simple and robust, giving a high standard of performance. They are easy to set up, interconnect, test, and, most important, to use; the quality of the documentation plays a big part in making this possible.

The cost of the equipment is a controversial matter; the overpricing of the computer has been discussed in these pages more than once. At around £7,000, the system is clearly not going to find its way into many people's homes. But even at that price I feel that a graphic designer, a computer-aided design consultancy or an architectural practice might well be among those who could make the system pay for itself within a reasonable time.

Although the system cannot be regarded as being one for the hobbyist, unless he happens to have just won the pools, it does illustrate just what can be achieved with a personal computer. The system also shows how manufacturers are using microcomputers to achieve the kind of functions previously available only on mainframes. Not only does this make the system more affordable, it also makes it inherently more reliable — if the mainframe breaks down 20 users are unable to operate, if the micro crashes you can always borrow the system next door!

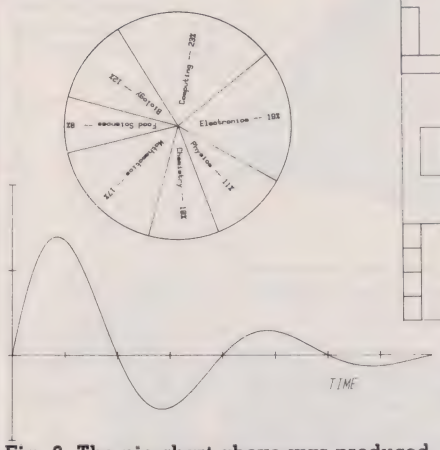


Fig. 1. The sine wave plot shown left can be produced using the standard graphics commands.

Fig. 2. The pie chart above was produced using the program listed in the text and the AGL commands.

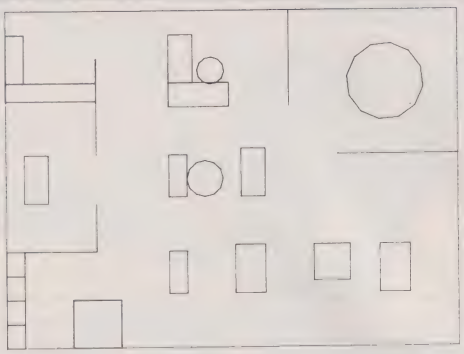


Fig. 3. Architectural plans such as those above can be built up from a number of standard shapes.

ALPHA Sets the display to alphanumeric mode.

BPLOT character string, number of characters per line
Plots a group of dots on the graphics display as specified by the character string.

DRAW x-coordinate, y-coordinate
Draws a line from the current pen position on the graphics screen to the x,y coordinate position specified.

GCLEAR [y]
Clears the graphics screen from the specified y value to the bottom of the screen, or the entire screen if no parameter is specified, in current pen colour.

GRAPH Sets the display to grapics mode.

IDRAW x-increment, y-increment
Incremental draw. Draws a line from the current pen position to the position determined by incrementing the current pen coordinates by the specified increment values.

IMOVE x-increment, y-increment
Incremental move. Moves the pen from the current pen position to the position determined by incrementing the current pen coordinates by the specified increment values.

LABEL character string
Writes a character string on the graphics display at the current pen position.

LDIR numeric expression
Label direction. Specifies the direction for labels in graphics mode. Horizontal labels are specified by values less than 45. Vertical labels are specified by values greater than or equal to 45. Default label direction is horizontal.

MOVE x-coordinate, y-coordinate
Moves the pen to the specified coordinate position without drawing a line on the graphics display.

PEN numeric expression
Specifies whether the plotting is done with white dots or black dots. When the expression is positive, a white dot is specified; when it is negative, a black dot is specified.

PENUP Lifts the pen; inhibits line generation.

PLOT x-coordinate, y-coordinate
Moves the pen from the current point to the specified location, drops the pen and makes a dot. If the pen was down, draws a line from current point to specified point.

SCALE x min, x max, y min, y max
Scales the graphics display in user-defined units. Default values are 0, 100, 0, 100.

XAXIS y-intercept [,tic spacing [,x min, x max]]
Draws a horizontal axis on the graphics display. Tic marks and initial and final x values can be specified. Positive tic parameters specify the left side of the screen as a reference, negative tics specify the right side as a reference.

YAXIS x-intercept [,tic spacing [,y min, y max]]
Draws a vertical axis on the graphics display. Tic marks and initial and final y values can be specified. Positive tic parameters specify the bottom of the screen as a reference, negative tics

specify the top of the screen as a reference.

Table 2. The Extended BASIC graphics commands available on the HP-83.

AXES [x tic spacing, y tic spacing [,x-intersection, y-intersection [,x major count, y major count [, tick size]]]]
Draws a pair of axes with optional major and minor tic marks.

CLIP [x min, x max, y min, y max]
Redefines the plotting boundaries.

CSIZE height [,aspect ratio [, slant]]
Specifies the form of the characters used in labels.

FRAME
Draws a frame round the current plotting area.

GRID [x tic spacing, y tic spacing [,x-intersection, y-intersection [,x grid spacing, y grid spacing [,tic size]]]]
Draws a grid marked in the same way as by AXES.

IPLOT x-increment, y-increment [,pen control]
Gives plotting relative to the current pen position.

LAXES [x tic spacing, y tic spacing [,x-intersection, y-intersection [,x major count, y major count [,major tic size]]]]
Draws a pair of axes and labels them.

LGRID [x tic spacing, y tic spacing [,x-intersection, y-intersection [,x grid spacing, y grid spacing [,tic size]]]]
Draws and labels a grid.

LIMIT [x min, x max, y min, y max]
Sets the plotting limits.

LINETYPE type number [,length]
Sets solid or dashed lines for use in plotting.

LOCATE [x min, x max, y min, y max]
Locates boundaries for plotting graphs. Labels can be placed outside these boundaries.

LORG label position
Establishes location of label relative to current pen position.

MSCALE x-offset, y-offset
Re-defines the origin and sets units for plotting as millimetres.

PLOTTER is select code [HPIB address code]
Specifies the target device for all the graphics commands.

RATIO
Gives the ratio of the physical limits of the plotting area.

RPLOT x-relative, y-relative [,pen control]
Gives relative plotting with pen control.

SHOW x min, x max, y min, y max
Provides equal-length units on both scales.

TRANSLATE
Translates program statements currently in memory to statements compatible with printer/plotter ROM.

UNCLIP
Resets plotting boundaries.

Table 3. Extra graphics commands of AGL.

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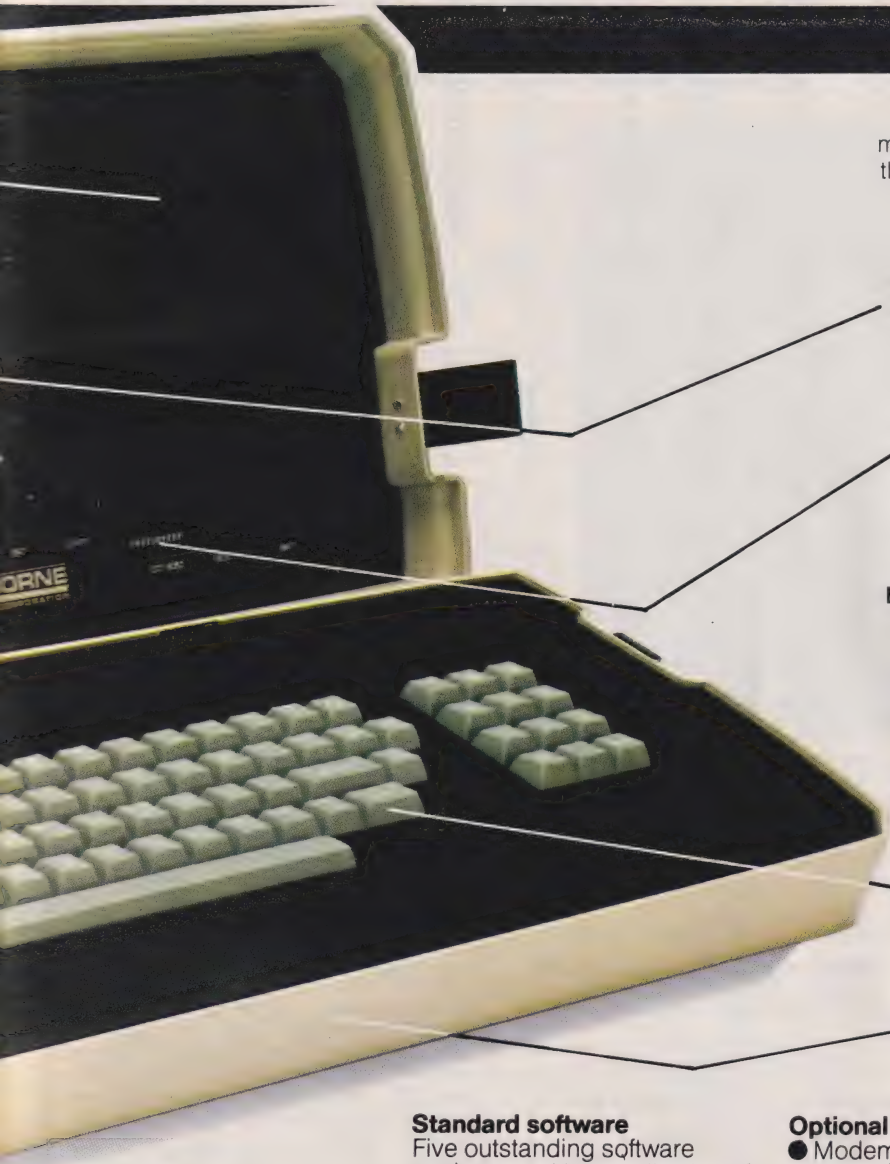

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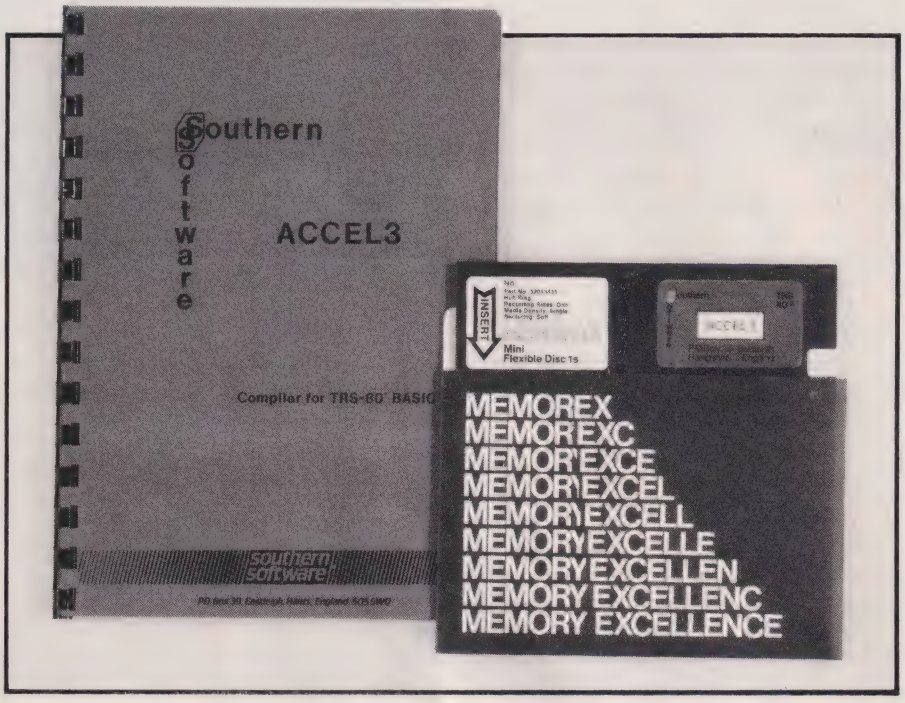
COMPILERS

Simon Goodwin

After last month's piece on interpreters we take a look at the other method of getting BASIC programs into a form that can be used by the micro.



In the last issue we explained some of the features of compilers for BASIC personal computers. This month we will look at one ingenious commercial product — the ACCEL2 compiler for TRS 80 and Video Genie. This program demonstrates many of the strengths and weaknesses of compilers in general. We're grateful to Southern Software, the UK authors, for permission to describe some of its inner workings as they illustrate many of the points that a user should consider when attempting to enhance the features of almost any BASIC micro. There is no reason why a compiler along the lines of ACCEL2 could not be written for any of the popular computers.

Briefly, a compiler is a program that translates BASIC statements from the 'tokens' in memory (eg FOR, GOTO, etc) into machine code. Once a program has been translated it is much more difficult to modify than when it was 'interpreted' but it can be run ten or more times faster!

Loading And Using ACCEL2

The compiler was supplied on digital cassette, accompanied by a strikingly-bound 18-page manual (it is compatible with disc systems). Two identical copies of the program are recorded on the tape, which is loaded using the Level 2 BASIC SYSTEM command since it is a machine-code routine. When first run, the message "TARGET ADDR?" appears. This feature allows you to store the compiler anywhere in your computer's RAM. The program will automatically move itself to the target address that you specify in answer to the prompt. That means it is compatible with all 'memory sizes' (so long as there is enough room for it to load in the first place). Normally you should reserve an area of memory out of reach of BASIC when the machine is switched on. The program doesn't check that the memory address specified contains free memory but only the most confused programmer would consider that a problem. The manual contains a useful table of suggested storage areas for different systems.

The ACCEL2 compiler is remarkably small — it only occupies 5½K of user RAM and loads in less than two minutes. About three-quarters of it can be deleted once compilation has taken place (most of the program does the translating rather than support the operation of the final compiled BASIC program). Once the compiler is in memory, you may load or type in any BASIC program that will fit into your remaining RAM. You may even RUN the program in the normal way and it will execute as if the compiler was not there. When you think there are no more errors in the program, you may compile it by typing the new command /FIX. A 14K program should compile in about two minutes. There is no way to interrupt the compiler while it is working; if you press the Reset button before the prompt re-appears, you will have to reload both programs before you can get any sense out of your system.

How It Works

The compiler works by looking through the BASIC program in memory and trying to find instructions that could easily be performed in machine code. It would not be possible to fit a full-feature compiler into only 5632 bytes of Z80 machine code, so ACCEL2 sets out to translate only those functions that can be enhanced most dramatically by compilation. It relies upon the fact that once the program is compiled, it cannot be edited. That means that most of the searches carried out by the interpreter can be replaced by simple instructions that fetch data directly from some pre-calculated memory address. These addresses are worked out by ACCEL2 while compilation takes place and are stored immediately inside the compiled program. The Z80 processor used in Video Genie can only directly process numbers in the range — 32768/+32767 (the range that can be stored in one of its 16 bit registers). Integer (whole number) values on most mini and micro-computers fall into this range and are useful as general-purpose stores in programs. Loop counters, graphics co-ordinates and 'flags' are generally integer values and Apple, Tandy and PET computers all support special 'integer variables'.

The Z80 instruction set includes integer addition and subtraction but not multiplication, division or complex functions such as square-root. These must be performed using a large number of machine code instructions and consequently ACCEL2 does not directly compile

them. All GOTOs and other line number branches can be compiled since the target of a branch is static. ACCEL2 replaces those instructions by machine code JUMPs. This is a most valuable improvement over interpreted BASIC — a Z80 jump takes about five millionths of a second on a TRS80 or Video Genie (even less on a computer with a 6502 processor like Apple or PET). The BASIC interpreter won't even have worked out what comes after the GOTO, let alone check the syntax, convert the number to binary and search all the way through memory to find the line required!

There are quite a few other BASIC functions that can be handled directly by the processor. Graphics commands such as SET, RESET and POINT are really only elaborate ways of setting or clearing bits in the computer's video RAM. ACCEL2 replaces them by calls to a set of simple subroutines. GOSUB and RETURN have direct machine code equivalents, and very little code is needed to simulate a FOR...NEXT loop since it usually only uses integer addition, comparison and jumps (so long as the index variable is an integer — and this is usually the case). PEEK and POKE are simply compiled and constants (such as "FRED", -1000, 3.14, etc) are stored as binary values.

As well as translating those statements into machine code, ACCEL2 is faced with a large number of other more complex operations: floating-point calculations; string-handling; and so forth. These are compiled in a rather different way. The data to be processed is fetched as detailed above but rather than operate upon it directly, ACCEL2 calls up routines within the ROM interpreter to actually work out the results. Even though it is the same code 'doing the work', the BASIC interpreter normally spends so much time searching for data that ACCEL2 can usually speed up those functions by three or four times. Most functions that are very complex (such as SIN and all the varieties of PRINT) are left in their interpreted form, keeping the size and complexity of the compiler down. You may choose to compile only a part of your program at a time and ACCEL2 will automatically take over from the interpreter when it comes to a compiled statement, relinquishing control later. It is this feature that makes ACCEL2 interesting to the programmer since it permits a compiler to be written piecemeal, one function at a time. In fact ACCEL2 was written in this way — the original 'ACCEL' being a 2¾K program that only compiled branches and most integer operations. It is still available (for half the price of ACCEL2) and is ideal for games and similar programs.

ACCEL2 converts compiled statements into REMs followed by machine code. To prevent confusion and to reduce the size of the compiled program, genuine comments are removed from the BASIC before it is compiled. Despite this, compiled programs are usually larger than their interpreted equivalents.

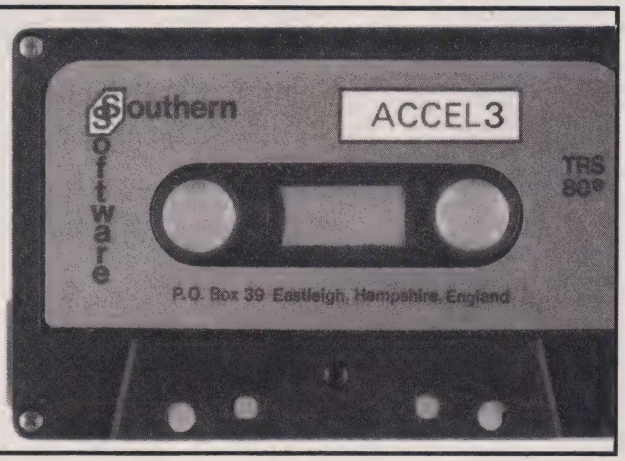
To accomplish the handover of control between compiler and interpreter, a very valuable feature of Microsoft (and most other) BASIC interpreters is used. You may have been disappointed to discover that on your PET, TRS 80 or Apple not all of the internal memory can be used to store BASIC programs. The interpreter borrows a few hundred bytes to store partial results of calculations and various other notes on the progress of a session at the keyboard. There is also a table of memory addresses (or JUMP instructions) in RAM and the interpreter calls at those locations at various key points in the execution of a program. There are about fifty 'vectors' in reserved memory on a Video Genie or TRS 80, and two of them are of special interest to compiler authors since they are used just before each direct command is processed and before statements are executed. On a Video Genie or TRS 80 (Model 1 or 3) these vectors are stored at 41B2 Hex and 41C4 Hex — other interpreters will have equivalent vectors at different addresses.

Normally the vector locations contain nothing more than a jump back into the depths of the BASIC ROM but if a machine code program wants to take over at times, it need merely replace the vector in RAM with one pointing to its own routines. It can check what's going on when it is called up and either jump back to ROM if it doesn't want to interfere or process the statement in its own way and then re-enter the interpreter at the point where the next instruction is fetched. Extended BASICs and 'Toolkits' use these vectors to add to the commands on a computer — once the relevant locations have been found, a user can expand the system software of his computer little by little; there are books available describing the workings of most of the popular microcomputer interpreters. My recommendation for TRS 80/Video Genie users is 'Pathways through the ROM' distributed by The Software.

The latest version of Southern Software's ACCEL program is ACCEL 3. Available on tape or disc it is accompanied by a startling orange manual, definitely not the thing for sore eyes!

To ensure that ACCEL2 will use the same variable storage area as BASIC, it checks through memory during compilation working out where each variable will be stored and where each line of the program will eventually end up. To make the compiled program exactly compatible with normal BASIC, ACCEL2 has to do a certain amount of 'housekeeping' as it runs. For this reason the compiled program is usually somewhat larger than the original version. To try to minimise that effect, ACCEL2 removes comments and unneccessary spaces from the BASIC before compiling it. ACCEL2 will issue an OUT OF MEMORY error if the compiled program ends up too large to fit in your computer. Often you can get around this by only compiling the part of the program that is executed most often. This keeps code expansion to a minimum and with care, the mixed code will run almost as fast as if it were all compiled. After such an error you have to reload a copy of the original 'source' BASIC entered using the interpreter; you cannot edit the partially-compiled program to cut it down.

ACCEL2 has facilities to allow a compiled program to load another from disc. It automatically looks for a compiled version first and then for an interpreted one if the first search fails. That feature allows a disc user to compile a set of linked programs one at a time (without having to recompile at each stage). The new disc commands are /LOAD, /SAVE and /RUN.



The cassette version of ACCEL is totally relocateable, a useful facility allowing you to have a variety of other programming or editing aids resident in memory at the same time.

Example Program

Figure 1 shows a simple program before and after compilation. The '%' signs indicate that X and Y are integer variables. These should be used whenever possible in compiled programs since they can be processed much faster than normal floating-point variables. It is not very valuable to try to compare the speed of individual instructions when interpreted and compiled, since the larger the program the longer the interpreter spends finding a given variable or line. A compiler will take a long time to translate such a program as it is doing at one step all the searching and converting that the interpreter does bit by bit (and generally over and over again!). This tiny example was compiled by ACCEL2 in less than a second and ended up using rather more memory than the original — 169 bytes instead of 126. The routine simply turns the entire computer display white by individually turning on each of 6144 graphics pixels. Interpreted BASIC took 36.5 seconds to execute the program; after compilation it ran in just five seconds. This speed improvement of around seven times is obviously not typical since most programs will use complex functions such as PRINT and decimal arithmetic. There again, ACCEL2 is at its least impressive when compiling small programs, and most programs will be accelerated by at least a factor of two or three times if they are compiled.

The compiled program may look rather odd; the original REM has been removed from line 100 but the line number alone is left there in case it is referenced by other parts of the program. The REMs conceal the compiled machine codes; ACCEL2 deliberately prevents the machine code from being listed (it wouldn't make sense, either to you or to the LIST routine . . .). END is never compiled so it appears unchanged.

```
100  REM ** ACCEL2 DEMO PROGRAM
110  FOR X%=0 TO 127
120  FOR Y%=0 TO 47
130  SET (X%,Y%)
140  NEXT Y%
150  NEXT X%
160  END

(126 BYTES, RUNS IN 36.5 SECONDS)

100
110  REM
120  REM
130  REM
140  REM
150  REM
160  END

(169 BYTES, RUNS IN 5.0 SECONDS)
```

Fig. 1. The example program before and after compilation by ACCEL 2.

Compiler Restrictions

ACCEL2 cannot compile array references with more than one dimension but this is not normally a major restriction. The size of an array must be known at compilation time (10 INPUT A 20 DIM CD(A) is not legal) but this can be avoided by always dimensioning arrays to the largest size required. ACCEL2 will be of little use in programs limited by the speed of peripherals such as disc, tape or printer. A version of Conway's game of LIFE has been written and found to be 39 times faster under ACCEL (the original 2¾K subset of ACCEL2) than when the BASIC interpreter alone was used. However, the program was written especially to be compiled and consequently a slightly faster interpreted routine could probably be found.

READ and DATA statements are not compiled since ACCEL2 cannot tell whether DATA is going to be stored in string or numeric format when the program is run. READ and DATA can be invariably replaced by assignment statements so this is not a major problem. ACCEL2 will only compile statements that it can translate completely. Although SIN, TAN and most other complex arithmetic operations are not compiled directly, ACCEL2 uses a neat dodge to compile comparisons using them. The line:

```
300  IF SIN(X)=SQR(X) THEN 100
     ELSE 200
```

is compiled into:

```
300  TO%=SIN(X)=SQR(X):REM
```

(That first statement is perfectly legal interpreted BASIC!) The compiler uses TO% as a temporary variable to store the result of the comparison (try PRINT 2=2 and PRINT 2=1 on your computer). The compiled code behind the REM tests the value of TO%; it will be zero if the values are not equal, −1 if they are. TO% is not a legal user variable anyway because the BASIC editor treats it as a reference to the reserved word TO.

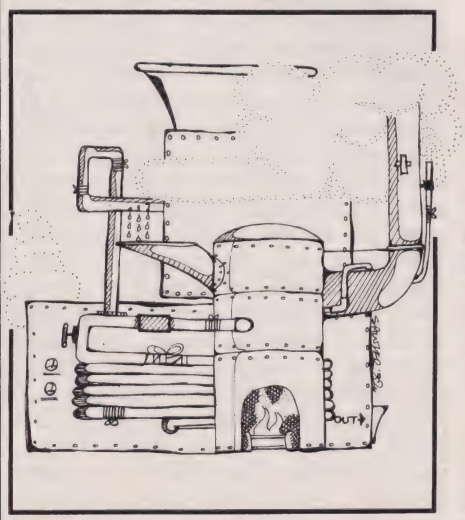
Most compilers generate a good many problems as well as advantages by comparison with an interpreter. ACCEL2 is a special case since it remains dependent upon the computer's ROM interpreter. It is possible to test a program 'in slow motion' with the interpreter and the usual BASIC debugging aids, and then to compile the program when it is (hopefully) more or less free of errors. This is important since there is not much room for error-trapping code in the 1280 bytes of run-time routines. After ACCEL2 has been used you cannot edit the program, delete lines or change the text in any way. If you try to do so, the interpreter will 'fall over' the machine code generated by ACCEL2 and the system will probably re-boot. You may still set or print variable values in immediate mode and then GOTO the start or middle of the program to test specific routines. It can be risky to GOTO lines in the middle of the program since ACCEL2 will not recognise an accidental 'Return without Gosub' error and will probably jump away to some indeterminate location quite possibly crashing in the process. GOSUB and REM are not allowed as immediate commands since ACCEL2 uses a different type of GOSUB from BASIC and it uses REM to signify compiled code. When the machine

holds a compiled program, you should not use the commands EDIT, AUTO, CLOAD?, CSAVE, DELETE, MERGE and SAVE, since they assume that the program is in interpreted format.

The compiler gains some of its extra speed by dispensing with part of the 'housekeeping' done by the interpreter; it doesn't check the current line number while executing compiled code so ON ERROR GOTO may not go where you want it to! Likewise TRACE will only display the line numbers of statements that have not been compiled. ACCEL2 doesn't check the 'Break' key while it executes compiled lines; if you 'get stuck' in a compiled loop you will have to use Reset to get out.

We were only able to find one minor bug in the purchased compiler; if INKEY$ was followed by certain statements a cumulative Out of Memory error could develop. However, this problem has been fixed in the current issue of the compiler.

ACCEL2 imposes a number of subtle restrictions upon the programmer. Lazy BASIC programmers have been known to write code that jumps out of a loop without terminating it, as in Fig. 2. This may fail under ACCEL2 since the compiler never realises that the loop has been terminated. The code in Fig. 3 works correctly whether interpreted or compiled and as BASIC on the Apple 2 also requires this construct, the limitation is quite a reasonable one. The program will also fail if the default type of variable is changed (eg from integer to string). This can sometimes happen by accident when Microsoft 12K BASIC is being used since variables are assumed to be floating-point until declared otherwise. Arrays should be dimensioned at the start of our program.



```
10  REM ** ACCEL2 COMPILER
    RESTRICTION
20  GOSUB 50
30  PRINT "RETURNED"
40  STOP
50  FOR I=1 TO 10
60  IF I>X THEN RETURN
70  NEXT I
80  RETURN
```

Fig. 2. A lazy programmers loop which night fail under compilation.

```
10  REM ** ACCEL2 REVISED LOOP
    CODING
20  GOSUB 50
30  PRINT "RETURNED"
40  STOP
50  FOR I=1 TO 10
60  IF I>X THEN J=I:I=10:REM ** SAVE
    VALUE OF I BEFORE RETURN
70  NEXT I
80  RETURN
```

Fig. 3. The correct way to do it for both interpreted and compiled programs.

With the exception of the INKEY$ bus, these restrictions are clearly listed in the ACCEL2 manual. Generally the compiler will work faultlessly on programs that have been written with it in mind and the effort needed to conform with its idiosyncracies is not great. A machine code monitor is required to save compiled programs on tape since they are a mixture of BASIC and machine code, and must be saved along with the 1280 byte ACCEL2 run-time routines. If this is done a compiled program becomes a self-contained file that can be loaded from SYSTEM and then RUN as if it were high-speed BASIC. If no monitor is available then all of ACCEL2 must be loaded whenever a compiled program is required and each program has to be re-compiled from the source before use.

Conclusions

ACCEL2 is a British development that illustrates a fascinating system of 'selective compilation'. The same techniques could be applied to almost any BASIC microcomputer and in fact, an even more powerful compiler could be developed step by step. Program compilation seems certain to become a popular technique in the future — ACCEL2 demonstrates an ingenious approach that combines many of the best points of compilers and interpreters.

Postscript

Since ACCEL2 was reviewed we have received a pre-release copy of the latest Southern Software compiler, imaginatively named ACCEL3. The new program is apparently a complete re-write of ACCEL2 and incorporates some new features.

ACCEL3 will compile non-structured FOR...NEXT loops making it possible to compile programs containing jumps out of loops, conditional NEXT statements and so forth. ACCEL2 didn't do this often leading to changes being made to a program before it could be compiled. The snag is that the extra code to handle unstructured loops slows up compiled programs — FOR... NEXT statements used with the new compiler are about half as fast as they were under ACCEL2. Similarly ACCEL3 now compiles references to arrays with more than one dimension but the speed of access to one-dimensional arrays has suffered.

ACCEL3 compiles some functions that ACCEL2 used to leave for the BASIC interpreter to handle. In particular, floating-point FOR... NEXT loops and functions such as INT and SQR are now compiled into ROM calls. The compilation of the functions (eg SIN, etc) doesn't really speed them up since they take much longer to process than to interpret but it does mean that expressions using them can be compiled. This would speed up the multiplication in X=SIN(X)*3.1416, for example. The USR(n) function, used to call a machine-code routine, is no longer compiled. ACCEL3 will also compile programs which use variable-bound arrays, such as – 20 INPUT N : DIM A$(N,2).

The ACCEL3 sales literature claims it is faster and generates more compact code than ACCEL2, but the difference in performance does not seem to be that great; the new compiler no longer has the disc commands /SAVE, /RUN and /LOAD. ACCEL3 allows compiled programs to be SAVEd, RUN and LOADed just as if they were normal BASIC although they will not work unless the run-time routines of ACCEL3 are in memory. Even the cassette commands, CSAVE and CLOAD, can now be used to store and retrieve compiled programs.

The pre-release version of the ACCEL3 compiler has been tested using it to speed up a few well-known programs — it even found one or two unnoticed syntax errors! More than half of the programs compiled first time and most of the rest could be compiled once a few lines were shortened or expressions simplified.

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This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

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The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

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The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.

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SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

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ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

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Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

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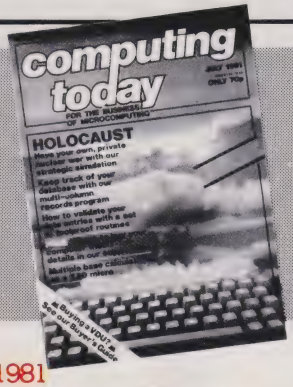

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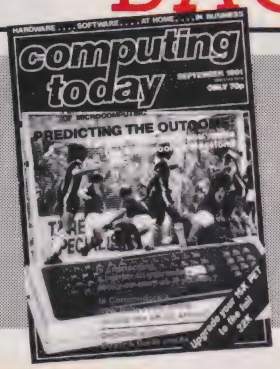

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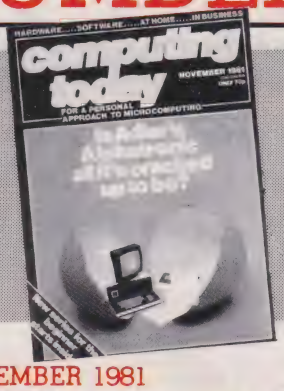

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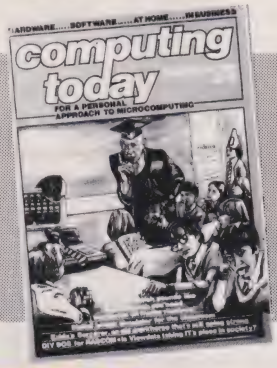

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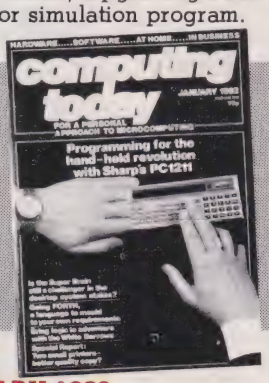

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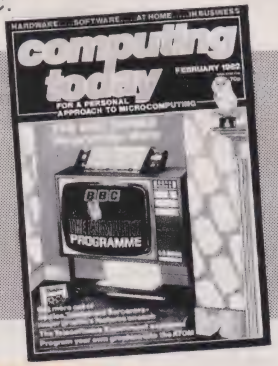

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Peter Freebrey

One of the first things you learn about computer programs is that they often seem to stop working through no apparent fault of yours. The causes are generally user error and the techniques used to overcome them are known as crashproofing.

Having begun to use IF... THEN we now have program execution jumping around all over the place! Our programs are becoming capable of generating their own answers and if those answers are not within certain limits set by our program, the computer can alter (or ask for further data) and re-RUN the problem.

As we progress with our programming, our programs are getting longer and more ambitious. We are probably getting to the stage where we will wish to RUN a program for our friends or family to see, or for them to participate in themselves.

Starting Off

When we develop a program for ourselves we know (or think we know!) what sort of answer or information the computer is expecting us to give it. Consider the following few lines which might appear at the beginning of a program:

```
10 INPUT "WHAT IS YOUR NAME ";N$
20 INPUT "HOW OLD ARE YOU ";A
30 INPUT "WHAT IS TODAY'S DATE ";D$
```

You know what answers the computer expects... because you wrote the program and during its development you probably typed in the answers to these lines many times!

Let us look at each line more closely. Line 10 is pretty clear cut, it is expecting someone's name (eg JOHN SMITH) and this has been assigned to N$. You have assigned a string variable because it is a fair bet the answer supplied will be letters of the alphabet rather than numeric characters. So far so good, but what if your young son brings home a school friend and wants to show him Dad's new program. Murphy's Law being what it is, the friend's name is probably Arthur James Cholmondely and you can bet that he ***always*** signs his name in full! The display will now look something like this:-

```
WHAT IS YOUR NAME ? ALFRED JAMES CHOL
MONDELY
```

Not an inspiring start is it? The amount of overlap will depend upon how many characters your computer can display per line. Line 20 expects a numeric INPUT, you have probably keyed in different ages as you developed the program. But did you consider that Alfred James might simply type in TEN... rotten little brat isn't he, crashing our program like that.

In line 30 you could look ahead and forsee that today's date could logically be entered in a variety of forms (22nd Feb 1982, 22-2-82 or even 2-22-82) so you thoughtfully used a string variable D$.

Unfortunately there is a possible format that could still bring about your downfall! It is conceivable that someone might enter the date as 22, 2, 1982 or 22:2:82. Depending upon your computer this might stop the program or if not stop it, cause an error message to be displayed...something like EXTRA IGNORED, and the date variable D$ would be assigned the value 22. The reason for this is that an INPUT statement can expect one or more variables, so:

```
120 INPUT X$,Y,Z$
```

and when entering these, they would be separated by a comma, so:

```
ARTHUR,2001,CLARKE
```

What the computer is telling us in the example above is that 'human, you have erred but do not concern yourself. I will ignore the extra, uncalled-for INPUTS'. The computer is always right, it is we fallable homo sapiens that cause the confusion.

Likewise, the colon can be regarded as a separator on computers that accept multistatement lines — what follows the first colon is also ignored!

Bombing Out

You can guard against some of these problems by being more definite in your requests for answers. Line 10 could simply ask for the Christian name; there are not many of those that are too long... or are there? You could PRINT the question on one line and request the INPUT on another — that would at least give you the full width of the screen to play with. Line 20 could use a string variable but we have seen from line 30 that even that can be open to misuse. If you are going to use the information that is being INPUT for calculations later in the program then you ***must*** be more explicit in your questions. "WHAT IS TODAY'S DATE?" for example could be split up something like this:-

```
30 PRINT "WHAT IS TODAY'S DATE"
40 INPUT "YEAR ";Y$
50 INPUT "MONTH (1-12)";M$
60 INPUT "DAY (1-31)";D$
```

These suggestions will certainly help the situation but are by no means a complete answer. You must write your programs so that they are 'idiot proof' or perhaps 'friendly computer programmer proof' (they always seem to find the chinks in our armour!).

A great deal of time and money has been spent on trying to make programs 'crashproof' and although it can be done, total crashproofing can be a complete project in itself. It often uses up an enormous amount of your valuable memory space for this purpose alone. Nevertheless it is good practice to take at least some elementary precautions with even the simplest of programs.

A good place to start is the instruction book for your computer. Hook up the pages that refer to the Error Messages of Report Codes or whatever your manual calls them. Just read through the possibilities and see if your program could conceivably give you a situation where any of them could occur. Some are obvious programming faults such as finding a RETURN without first having a GOSUB but others can be quite insidious. For instance, if a program is RUNning and reassigning variables, could you have a division by zero? Could you inadvertantly try and generate a number larger than is permitted?

Study your programs carefully and incorporate some of those IF... THENs that we used in our last article. Check for the limits of variables that might cause problems. Make sure those variables are of a type (string or numeric) and length which

the program can deal with sensibly. To guard against errors arising from INPUT statements is a good place to start. Unfortunately, different computers have working structures that do not lend themselves to universal crashproofing routines. The following variations will give you some idea of what we are trying to do and you should be able to derive a routine for your own personal brainbox.

What happens if you key RETURN (ENTER or NEW LINE) on being prompted for an INPUT? Some computers come to a dramatic stop, others continue to the next program line, still others are very user-friendly and will repeat the prompt for an INPUT. Let us look at ways in which we can guard against errors incurred by the first two systems above.

First, the computer that jumps out of a RUNning program on a RETURN with no INPUT entered. An offender here is the PET, one approach using cursor control, is as follows:

```
10 INPUT "YOUR NAME [4CR]*[3CL];N$
20 IF N$ = "*" THEN 10
```

Line 10 first displays the prompt message then moves the cursor four spaces to the right — to the position where the cursor ***will*** be when it is awaiting the first character to be INPUT. At this position it displays an asterisk and then moves the cursor three spaces to the left. Now a '?' is displayed and the cursor ends up over the asterisk and will await an INPUT to be entered. If RETURN is keyed the '*' will be accepted as the INPUT but line 20 will direct the program back to line 10 and the prompt message will be repeated.

Remembering our friend Alfred James Cholmondely we could now add line 30:

```
30 IF LEN(N$) > 18 THEN PRINT "TOO
   LONG":GOTO 10
```

LEN (N$) determines the number of characters in string N$ and line 30 limits the number of characters to 18 (could equally well be 10, 16 or whatever you have chosen to suit your PRINT format).

If you wish to extract a numeric expression from an INPUT but at the same time guard against some 'clever clogs' typing in a string of non-numeric characters, the following routine shows how this may be done:-

```
100 PRINT "IMPERIAL TO METRIC
    CONVERSION"
110 INPUT "HOW MANY FEET [4CR]*[3CL]"
    ;A$
120 IF A$ = "*" THEN 110
130 IF A$<>0 AND VAL(A$)=0 THEN 110
140 A = VAL(A$)
150 PRINT A;" FT = ";A/3.281;
    "METRES"
160 END
```

Line 110 uses our INPUT protection against a RETURN without any entry. Line 130 determines whether A$ is numeric or not. VAL(A$) returns the numeric value of a string; all characters other than numerals and +, − and . will give a value of zero. So, line 130 is saying IF A$ is NOT the number zero but the numeric value of A$LS zero (non-numeric) then GOTO line 110. Line 140 determines the numeric value of a valid string (A$) and line 150 calculates and prints out the conversion.

Now for the computers that will simply move to the next program line if RETURN is keyed with no INPUT. An example of this type would be the Sinclair ZX81 and the TRS80. This is an easier problem to deal with, all that is necessary to ensure that something rather than nothing is INPUT is:-

```
10 INPUT A$
20 IF A$ = "" THEN GOTO 10
```

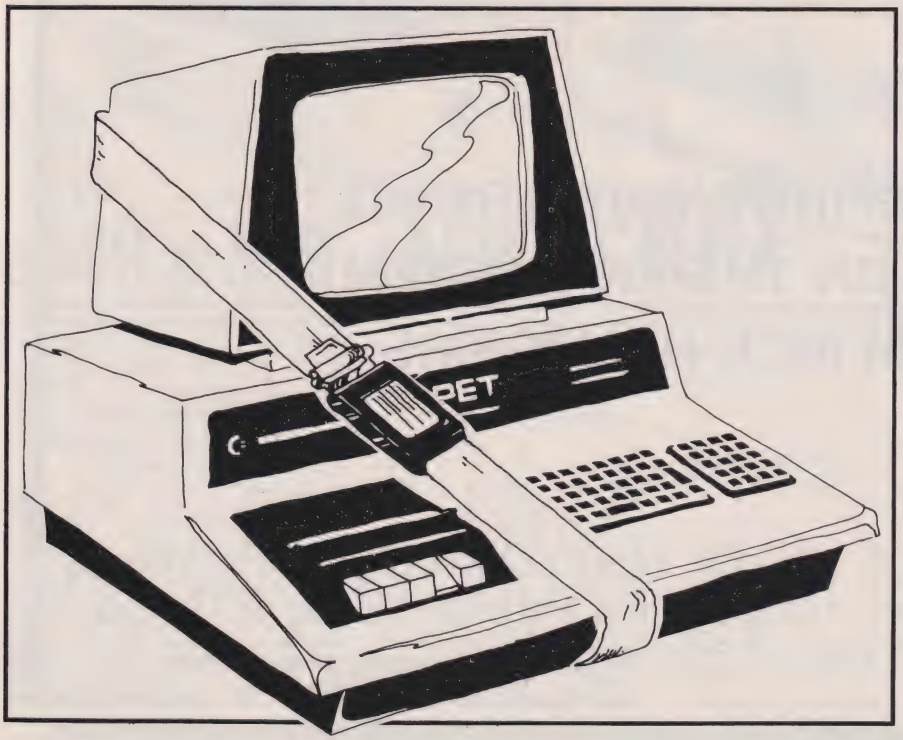
Line 20 simply checks to see if nothing has been INPUT and if this is the case directs the program back to line 10 to prompt for a further INPUT. If you wish to extract a numeric expression from an INPUT then the following will work for the ZX81:

```
30 FOR I = 1 TO LEN A$
40 LET C$ = A$(I)
50 IF CODE C$ < 28 OR CODE A$ > 37
   THEN GOTO 10
60 NEXT I
70 LET A = VAL A$
```

With the ZX81, VAL A$ will only give a numeric value for a string that is made up of numerals. If the string has non-numeric characters the program breaks with an error message. Lines 30-60 test to see if each character within string A$ is numeric. For each FOR...NEXT loop, line 30 assigns the Ith character in A$ to C$ so that each character is checked separately. Every character on the keyboard has a numeric CODE unique to the ZX81. Line 50 checks to see if the CODE of each character in A$ is numeric and if any are not, the program is directed back to line 10 to prompt for another INPUT. Line 70 assigns the numeric value of A$ to numeric variable A.

The third group that are more user-friendly in this particular situation include the Sharp MZ80 and the Texas TI-99/4A. These too, of course, will require various checks for the validity of any INPUT.

We have only just scratched the surface of this particular topic but I'm sure that you will now be more aware of some of the pitfalls and will probably be able to develop a number of routines to suit your own programs. Next month we will be looking at string-handling... how to slice up your text and put it back together again.



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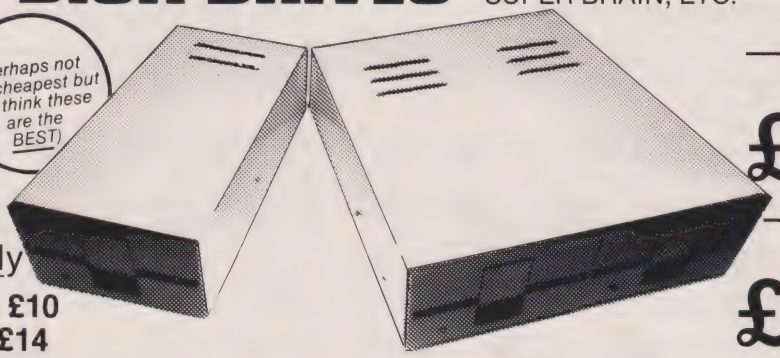

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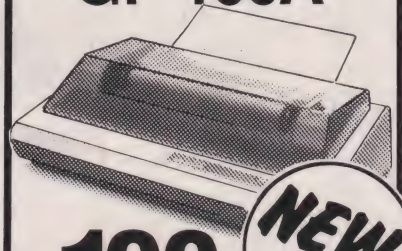

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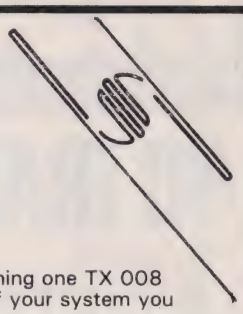

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Mike James

Although Microsoft are perhaps better known for their versions of BASIC, another of their products has achieved more than a little success. The SoftCard turns your Apple into a CP/M compatible system, something previously unattainable for a 6502-based micro. The question is 'what does that actually mean?'. The answers are here.

There is nothing soft about the SoftCard — it is a piece of hardware that can take your Apple into the world of CP/M compatible software.

Simply by installing this single plug-in card you can use the CP/M operating system, develop 8080 and Z80 code and run a standard version of Microsoft's BASIC V5.0. All this and you can still run the original 6502 and Applesoft BASIC any time you want to. If you place a CP/M disc in Drive One and 'boot up', the Z80 takes control and you have CP/M; if you place an Apple DOS disc in Drive One instead the 6502 takes control and the SoftCard sits doing nothing! If you own an Apple but hanker after a Z80 machine then the SoftCard ***could*** be the answer you have been waiting for!

System Requirements

Before going any further I should outline the minimum system the SoftCard will work with. You can have either an Apple II or an Apple II Plus with or without a language card (if you do have a language card then the extra 16K of RAM can be used by CP/M). You ***must*** however, have 48K of RAM — because this is the smallest CP/M system supplied; when you think that CP/M and MBASIC will use 29K of RAM this memory restriction is not so suprising. You also need at least one disc drive but, as always, two makes life easier. This can be either a 13 sector DOS or a 16 sector DOS unit, the SoftCard will work with either but I recommend that you upgrade to the 16 sector DOS anyway — the increased storage that results is well worth it.

As for extras, the manuals say that all standard Apple peripheral cards are supported along with some independently manufactured ones. I can certainly confirm that the VIDEX video card and the CSC serial card could have been made for SoftCard! The rule is that if a card works with Apple Pascal without any software modifications it should also work with the SoftCard. If all else fails however, there is a customising program, CONFIGIO, that will let you patch the I/O drivers for any completely non-standard peripheral card. The conclusion is that as long as you have a minimum 48K, one disc drive system, you can add just about any extras you fancy and still make full use of the SoftCard.

Installing The SoftCard

One thing you have to say for Microsoft is they certainly know how to package a product. The SoftCard arrives in a colourful box containing the card itself and two luxuriously bound manuals. Inside one of the manuals are two 5¼" discs — one for 13 sector DOS and one for 16 sector DOS.

The first, very minor, problem is in actually fitting the SoftCard inside your Apple. The manual gives very detailed step by step instructions that anybody could follow if they have the patience to read them! In summary, they say, plug the SoftCard in slot number 4, unless there's something in it — in which case plug it into any other slot except 0. This seems easy enough but there is one slight complication — the positions of all the other peripheral cards. In normal use, with Applesoft or Integer BASIC,

there is no need to worry about where any particular peripheral card is installed; as long as you know where a card is, you can redirect the I/O by making reference to its slot number. CP/M and Microsoft BASIC don't have any way of referring to the slot number so peripheral cards must be placed where CP/M (etc) expects to find them.

CP/M recognises four types of I/O device — the LST: device, used for output only; the PUN: and RDR: devices, normally the output and input sides of a single card; and CRT: or TTY:, the console output device. In the Apple CP/M the LST: device should be in slot 1, PUN: and RDR: in slot 2 and CRT: or TTY: in slot 3. The other slots can be used for disc controllers, colour cards and, of course, the SoftCard itself.

Obviously this allocation of devices to particular slot numbers may require you to move any existing peripheral cards you have around. For example, the card (serial or parallel) your printer is connected to should be in slot 1 and any video card (ie an 80 column display card) should be in slot 3. This is no real disadvantage once you have become used to the reassignment of slots but at first I cursed the system every time I directed output from Applesoft to the slot my printer used to occupy!

Any disc controller cards you may be using also have to be in particular slots. You ***must*** have a controller in slot 6. You can also use slot 4 and 5 making the maximum number of discs you can use with the SoftCard six — two per controller.

Disc drives in CP/M are referred to by letters, the first being called 'Drive A' and so on. In Applesoft, disc drives are referred to by two numbers: slot number and then Drive One or Two. The CP/M names correspond to Applesoft names as shown in Table 1.

Some black stickers marked 'Drive A' to 'Drive F' are provided inside one of the manuals so you can label your drives.

After you have installed the SoftCard and re-arranged your perhipheral cards to suit, the next task is to switch on and make a back-up copy of the valuable master CP/M disc. All you have to do to run CP/M is to place the appropriate disc in Drive A: and boot up (if you have an Apple II Plus this simply means switching on). After a few moments, filled by the familiar

Drive	CP/M Name	Applesoft name	
		Slot number	Drive Number
1st disc	A:	6	1
2nd disc	B:	6	2
3rd disc	C:	5	1
4th disc	D:	5	2
5th disc	E:	4	1
6th disc	F:	4	2

Table 1. The correspondence between the way CP/M identifies drives and the way Applesoft does it.

Installation under way on the Apple. It takes less than five minutes to fit the single PCB into the expansion slots and connect everything back together again.

sound of the Apple disc clicking, the message:

```
APPLE II CP/M
44K vers. 2.2X
(C) 1980 MICROSOFT

A>
```

should appear.

If you're not greeted by the sign-on message then the only things you could have done wrong are to install the SoftCard the wrong way round or be using the wrong CP/M disc. If, after checking these two points, it still won't work I can only think that some fault has found its way into the SoftCard. The point I am trying to make is there is nothing special you have to do to your Apple to make it work; if you have a working Apple and a working SoftCard then installation ***must*** be successful.

If you have a working system, as mentioned earlier, the first thing you should do is to make a back-up copy of the CP/M master disc. It would be a shame if a disc crash at this stage left you with working hardware and no software to use it with! Although I refer to the disc CP/M is delivered to you on as the master disc, there is no master/slave distinction in CP/M as there is in DOS. Any disc containing the CP/M operating system is as good as any other and you can copy a copy of a copy . . .

Before any disc can be used with Apple CP/M it must be formatted. Unlike DOS, CP/M uses a separate program called FORMAT to initialise new discs — also there is no 'HELLO' type program included on newly formatted discs. Once you have a formatted disc the task of copying the master system disc is made much easier by the provision of a COPY program. This is a general whole disc copy program that will work with either dual- or single-disc copying. After you have completed this task you can start having fun getting used to CP/M and the rest of the software. If you have a non-standard Apple system, ie you're using an external terminal or non-standard I/O, then you may not have the system working exactly as you want it to at this stage — I would advise getting used to CP/M before going on to configure the system any further.

CP/M v DOS

If you have only used Apple DOS then CP/M will come as a great shock to you. But, no greater a shock than Apple DOS was to those of us used to a real operating system! Apple DOS isn't really an operating system, it's a way of interfacing BASIC to a number of disc drives — it's about adding disc handling commands to BASIC. CP/M on the other hand is an operating system in the sense that it isn't tied to any particular language — you can run BASIC, Pascal, COBOL, FORTRAN,C, etc . . . all under CP/M. The DOS user will have to get used to various minor changes, such as saying DIR instead of CATALOG, and some quite major ones, such as being able to do things with discs without being in BASIC.

Having been slightly rude about Apple DOS, I have to add that it is a generally held view that CP/M is a minimum operating system — it is idiosyncratic and awkward to use. Why then go to so much trouble to replace a DOS with CP/M if it's so bad? The reason is that CP/M is the most widely used (micro) operating system in the world and popularity breeds popularity.

One of the most annoying and unnecessary features of CP/M is the need to 'log discs in'. If you want to change DOS discs then you just do it. If you want to change CP/M discs and use the new disc to write on, you have to do a CP/M 'warm start' by pressing CNTRL and C to log the disc in. If you don't you can read the new disc without any problem but if you try to write it you will immediately get an error message and possibly lose all of your valuable data. Another general problem with CP/M is that its error messages are more suitable for a system programmer than for the average user — they are cryptic.

All these criticisms, and many more I could make, still don't take away the strange feeling of freedom you get from using CP/M on the Apple. Simply by typing the name of a machine code program it is loaded and run. There is no equivalent of the BLOAD or BRUN commands because none are needed. This automatic running of programs gives CP/M the appearance of having extra commands, for example, suppose you wrote a Z80 or 8080 program to catalogue the contents of a disc in a special way and you called this program CAT then by typing CAT your program would load and run. This would look as if CP/M had an extra command called CAT.

However, this new-found freedom to load machine code programs can be something of a problem in that you have to load the BASIC interpreter before you can run any BASIC programs. Most Apples have Applesoft in ROM saving some 16K of RAM space but Microsoft BASIC takes around 24K standard and 32K if you want to use Hi-Res graphics — this cuts down the amount of space you have for user programs quite a lot!

One well-packed PCB and two manuals with a pair of floppy discs are the contents of the Microsoft package.

Microsoft BASIC v Applesoft

Microsoft wrote both Applesoft and Microsoft V5.0! This accounts for much of the similarity between the two. The system disc supplied with the SoftCard includes a version of Microsoft BASIC V5 — MBASIC that is entirely standard except for the addition of a few extra commands to make best use of the Apple's hardware. This is an important fact because one of the main reasons for using the SoftCard is likely to be the desire to run or develop BASIC programs in standard Microsoft V5. If the BASIC that comes with the SoftCard has any incompatibilities with the BASIC everyone else is using then this is an important defect with the whole idea. I've not found anything missing that should be there and I have run programs from other CP/M machines without any trouble. The only minor differences are TRON/TROFF becomes TRACE/NOTRACE; DELETE becomes DEL; the WIDTH command can be used to set screen height as well; WAIT examines an address rather an I/O port; and CLOAD, CSAVE, NULL, INP and OUT are not implemented. However, none of these differences or omissions should stop a program from being run on the Apple if it is at all possible!

The SoftCard is the PCB closest to the camera in this shot. The disc controller card will be re-fitted in front of it.

The extra features included in MBASIC for the Apple fall into two groups — those commands found in Applesoft and some completely new ones. There is also a version of the MBASIC called GBASIC; this includes the Applesoft Hi-Res graphics commands but is only to be found on the 16 sector disc because it is a very big program. The only commands that are not to be found in either MBASIC or GBASIC are the ones dealing with shape tables, ie DRAW, XDRAW, SCALE and ROT and some general ones such as FLASH, screen editing, STORE, RECALL, IN, PR, HIMEM, LOWMEM, LOAD and SAVE. The omission of the shape table commands is the only serious problem when converting Applesoft programs to GBASIC. The new commands are:

BUTTON(0) — a function to test if a paddle button has been pressed.

BEEP — a command that generates a tone of specific pitch and duration.

HSCRN(X,Y) — a function used to determine if a point has been plotted on the Hi-Res screen.

VPOS(0) — a function that returns the vertical cursor position. These are all statements noticeably missing from Applesoft since its introduction — imagine producing a computer with an internal speaker but without a BEEP command!

Apart from the omissions and additions, MBASIC and GBASIC also contain some slight variations in implementation from Applesoft. All in all, converting programs from Applesoft to MBASIC/GBASIC is not difficult, just fiddly!

There is no doubt that MBASIC is a full implementation of BASIC than Applesoft. There simply isn't enough space to catalogue all the advantages of MBASIC but I can't leave the subject without mentioning the CALL statement. Any Microsoft BASIC contains the facility to CALL a Z80 or an 8080 machine code subroutine. But only the SoftCard's MBASIC has the ability to CALL a Z80/8080 ***or*** a 6502 subroutine! If you use CALL Z then you would jump to a Z80 routine the address of which is stored in Z; if you'd used CALL %Z you'd have called a 6502 subroutine at the same address! The only difficulty is that the SoftCard rearranges the memory map of the Apple so you have to be careful about the meaning of 'same address'.

Other Software

There is no doubt that the two main pieces of software that come with the SoftCard are CP/M itself and MBASIC/GBASIC. However, there are also a few odds and ends that add to the usefulness of the whole system. First, you get the normal cluster of programs accompanying CP/M:

ED — the standard, though not-so-easy to use, text editor which is context- rather than line-oriented or screen-based. Personally, I prefer Microsoft's own EDIT80.

ASM — a fairly standard 8080 assembler. If you want a Z80 assembler then you'll have to buy one as an extra.

DDT — an 8080 machine code debugger.

Second, you get a set of Microsoft-written utilities, two of which, FORMAT and COPY, have already been mentioned. CONFIGIO is a BASIC program that allows the reconfiguring of CP/M's I/O and the redefinition of keyboard characters.

One of the defects of the Apple is that its keyboard lacks certain characters. Using CONFIGIO you can make ***any*** key produce ***any*** ASCII code. You still might not be able to display the new character but any software using it will recognise it when you press the key. RW13 is a program allowing you to read 13 sector discs from 16 sector CP/M; APDOS is similar but transfers Apple DOS text and binary files to CP/M; UPLOAD and DOWNLOAD transfer files from a standard CP/M machine to Apple CP/M, but more of this in the next section.

Compatibility

One of the reasons for the success of CP/M is that it makes the exchange of software and data between different machines possible. The advent of CP/M on the Apple may be thought to carry the same advantage. Unfortunately this is ***not*** so. The physical format of the Apple disc is very different from any other 5¼" disc.

Rather than use a floppy disc controller, the Apple uses a mixture of hardware and software to handle the disc at the bit level. This means that although Apple CP/M uses the same organisation of the disc as any other CP/M, from the point of view of how files are stored, it is ***totally*** incompatible with any other CP/M machine except another Apple! This might not matter too much as long as someone takes the trouble to transfer any CP/M software you might want to the Apple format; as you might expect most software is indeed available in Apple format but it pays to check before you buy a SoftCard if you are counting on using a particular program.

Microsoft have tried to overcome this incompatibility by producing the UPLOAD/DOWNLOAD programs. If you have an Apple with a serial interface you can transfer a program from another machine with a serial interface using UPLOAD/DOWNLOAD. The only trouble is that you have to bring the two machines together and connect them via their serial ports ***and*** you have to do some assembly language programming.

If you want ***true*** CP/M compatibility there is a way of achieving

it but it is expensive. One or two manufacturers produce 8" disc controllers for the Apple and are now offering CP/M for the SoftCard on 8" discs. If you bought one controller and one 8" drive the total cost should be around £1200 but you will be able to read other people's 8" CP/M discs straight onto your 5¼" Apple drives.

SoftCard Details

This section is for the hardware expert and the assembly language programmer. If you just want to use the SoftCard then you most certainly do not ***need*** to know very much about it!

The Apple is a very special machine in that each of the eight perhipheral slots at the rear of the machine contain a complete set of bus signals. It has always been obvious that it would be possible to replace the 6502 and allow another CPU to gain control of the machine via the peripheral slots.

It is one thing to produce a new CPU for the Apple, but it is another to provide the software to make it useful. Another problem is that interfacing another CPU using the peripheral slots is much more tricky than it looks! For one thing the 6502 is a dynamic device and must be kept running or the data stored in its registers will be lost. For another, the Apple's RAM is dynamic and its refresh (and screen display) cycle is interleaved with normal CPU operations.

A more obvious reason for not trying to run a Z80 and CP/M on the Apple is the very odd memory map which a standard Apple has! CP/M expects a clear block of memory from address zero right up to the top of usable memory. The Apple has text and Hi-Res screen areas at the start and in the middle of memory — effectively splitting the memory into two halves. All this makes the prospect of running CP/M on the Apple very bleak.

However, Microsoft have overcome all the difficulties. The problems of refreshing the 6502 and the memory have been overcome by locking the Z80 operation to the 6502's own master clock. The memory location problem has been solved by re-mapping all of the 6502's addresses to different Z80 addresses. In other words, the SoftCard has an onboard address translator producing the sort of memory map that CP/M needs! The correspondence between 6502 and Z80 addresses is:

Z80	6502	use
0000-DFFF	1000-FFFF	general RAM
E000-EFFF	C000-CFFF	memory mapped I/O
F000-FFFF	0000-0FFF	6502 page zero/stack/text screen

Z80 address	use
0000-93FF	Free user RAM
9400-AFFF	44K CP/M or free RAM if language card used
B000-B3FF	1K user RAM if language card used
B3FF-DFF9	56K CP/M if language card fitted
DFFA-DFFF	6502 RESET/NMI/BREAK vectors
E000-EFFF	peripheral slots
F000-F1FF	6502 stack and Page Zero
F200-F3FF	CP/M's I/O configuration block
F400-F7FF	Text screen
F800-FFFF	Disc drivers and buffers

Table 2. With these address changes in mind the SoftCard's and CP/M's use of the Apple's memory should make sense.

For special applications you can switch the address translation off but I find it difficult to think of an application that would need it. The SoftCard also supports the Apple DMA daisy chain and interrupts. If an interrupt occurs while the Z80 is in control it is still necessary to pass control to the 6502 because it also 'sees' the interrupt.

Examining the construction of the SoftCard reveals that it is well laid out. The tracks on the PCB are very thin but this shouldn't cause any concern because all the chips are socketed. The board itself is 7" long by 2½" inches high thus overhanging the perhipheral slot into the body of the Apple — but this presents no problems. In over six months use I have had no hint of any sort of trouble — an excellent piece of hardware.

Documentation

As I have already said the SoftCard comes with two luxurious manuals. I wish I could be as complimentary to the contents of the manual as to the bindings! It's not Microsoft's fault — their parts of the manual are relatively OK. The trouble is that they have made up two manuals for the SoftCard by rebinding a number of existing manuals, with small changes to take account of any special features of the Apple.

Volume One is about the SoftCard and CP/M. The section on the SoftCard (written by Microsoft) is OK and reads quite well but the sections on CP/M are taken directly from Digital Research's **CP/M User Manual** which is ***not*** a beginners' manual. I would recommend that if you find these sections difficult, buy one of the text books on CP/M — see November's Book Page in CT. The second volume is about MBASIC/GBASIC and the utilities. This once again is not a beginners' manual but contains all you need if you already know how to program in BASIC.

Conclusions

By now I should have left you in no doubt that I like the SoftCard. To be more precise I like ***my*** SoftCard! After using it for over six months I can't imagine getting by without it. Microsoft have put together a package of hardware and software which at £225 (including VAT and delivery) is extremely good value. Following the success of the SoftCard, other manufacturers have produced add-on CPU cards. At the moment the list includes a 6809 card, a 68000 card and an 8086 card. There isn't space here to examine any of these products but their existence does open up the fascinating possibility of buying an Apple just to have a multi-CPU software development facility!

Meanwhile, if you already have an Apple and you want CP/M then the SoftCard is the cheapest way to obtain it and is a very good route to choose.

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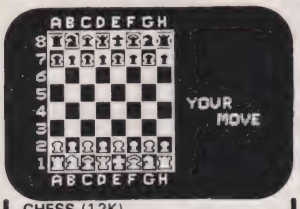

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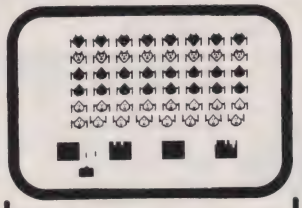

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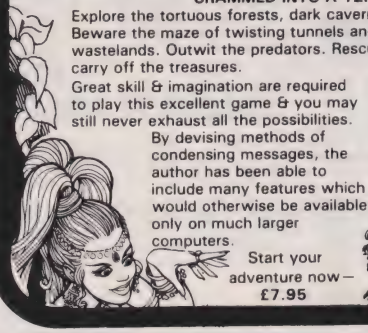

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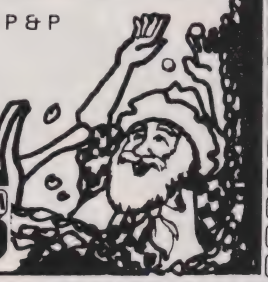

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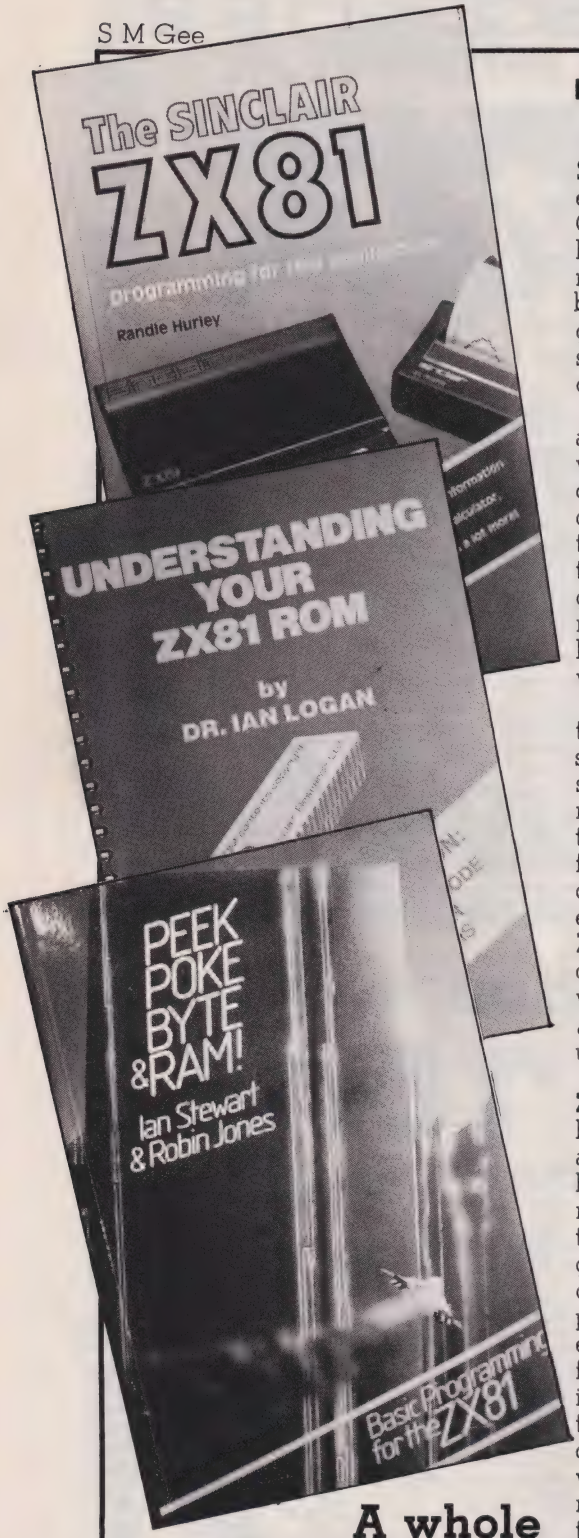

A whole bunch of books on, about, and for the ZX81 computer have been written over the last year. We examine a selection of the current titles.

The Sinclair ZX-81 has been with us for just a year. Last autumn it went on sale in W H Smiths and sold like hot cakes — especially in the two weeks before Christmas. After the initial novelty has worn off though, I wonder how many ZX-81s lie neglected in their boxes because frankly it's difficult to get something worthwhile out of such a small computer without a lot of hard work.

Books about the ZX-81 can serve a number of purposes for people who already own the machine. They can re-awaken interest in it, they can suggest useful applications, they can deepen understanding, or they can provide listings of programs worth trying out. Also, reading the available books will help non-owners to decide if they want to buy the machine.

In the pre-Christmas period there were very few books available specifically for the ZX-81. There were some hasty updates of ZX-80 material but these were unsatisfactory because the ZX-81's special features are those its predecessor didn't possess. However, I'm pleased to say, anybody interested in the ZX-81 now has a choice of books covering a range of topics — but it's worth making a careful selection as they do vary in quality and usefulness.

The Gateway Guide to the ZX-81 and ZX-80 was one of the first books available. It presented itself as 'a doing book, not a reading book'. Certainly, it is impossible to read but, at first glance, it seems as though a beginner would probably get quite a lot of fun using it with his or her machine switched on. It plunges straight in with a simple example demonstrating a number of features while being quite an amusing game at the same time. Most of the book is devoted to games — I counted about forty programmes I would assign to that category. These range from the short and simple to the long and complicated and are mainly implementations of well-known routines. Although the book's introduction suggests the programmes are easily convertible from machine to machine, in the case of many, it is almost impossible to tell from the explanatory sections whether the programs can be used straight away on both the ZX-81 and the ZX-80, many need only slight modifications or are specific to one or the other. This confusion stems from the problem I mentioned above — lots of games were written initially either for the 1K ZX-80 or for the 4K ZX-80 and not all of these will fit onto the ZX-81 equivalents for the simple reason that the ZX-81 needs more memory to run its BASIC. There are also some commands specific to the two different machines. Some of these, like the way each can be instructed to generate random numbers, are explained well but other commands seem to be left to the reader to work out. All-in-all it is not a book I would recommend.

Not only 30 Programs for the Sinclair ZX-81 is a collection of programs that can be squeezed into the basic 1K machine, most are games. The very first is a simple one that generates random patterns but the programs do become fairly sophisticated — considering the very limited amount of memory that is left over in the 1K machine once the BASIC has taken its share. The programmer resorts, however, to machine code in order to get the ZX-81 to play Draughts. Three utility programs: bubble sorting, line renumbering and a machine code editor are included. The programs have been written by a number of people but they are all presented in a similar format. First there is a description of what results when the program runs: usually an explanation of the game involved; next comes an overview of the structure of the program; then there is a listing of the program and finally notes on running it. The explanations are such that you will learn from them and should be able to graduate to writing your own when you've tired of those supplied.

Last time I went into my local WHS I spotted that two extra titles had appeared on the bookstand next to where the ZX-81 should have been — in common with lots of stores it had sold out of them! My first impression was that **The ZX-81 Pocket Book** offered a good deal to ZX-81 users including those to whom programming is very new. Trevor Toms' tips in the chapter on 'Efficient Programming' include useful advice on how to conserve space. Although a guide which aims to teach, there are a number of games programmes which are also available on cassette that can be bought as an extra.

The ZX-81 Companion, by Bob Maunder, will appeal to those who want to use their machines for more serious applications. Chapter two for example, discusses how to use the machine for information storage

and retrieval (for which the 16K RAM pack is essential) and chapter three describes 'The ZX-81 as an education tool'. Perhaps the best indication of the level this book is aimed at is given in chapter four, 'Examining and using the monitor' in which a good deal of the monitor listing is included.

Educare's 50 is a new departure. This is an applications handbook — not one giving you ideas for programs to write but one listing programs that you simply type in and run without any need to understand what's going on at all. It's designed for teachers and parents to use with children of primary school age. The instructions are deliberately simple; all the teacher is asked to do is to enter the program or at the most, make simple modifications to vary the games. The programs range from ones teaching counting and simple arithmetic to ones dealing with concepts of volume and balance. Lots of the programs teach through games that will be thoroughly enjoyed by children aged four to eleven. Details of how to use each routine are clearly stated but, because of the restrictions on space, the instructions to use them are presented in the book rather than displayed on the screen. No explanation at all is given of the programming techniques — its not that sort of book. But it's well worth other programmers taking a look as the author has used some really clever tricks. It takes ingenuity to get such results out of the unexpanded ZX-81. Children generally respond with enthusiasm to learning through computers and will probably learn quickly from these programs which deserve to be tried out in classrooms and homes. Persuade your local primary school to buy a copy of this book — and a ZX-81 to go with it!

My next selection takes the prize for presentation. It is a softback with a shiny cover and attractive cover design. Inside, it is 'properly printed' and has good diagrams and illustrations and some jokey cartoons introducing De Bugs (who are worth a book to themselves). As for the substance of **PEEK, POKE, BYTE, and RAM!** I found it sound as far as it goes, but it stops short and tends to duck the difficult bits. This is probably excusable in that it is a beginner's book. To its credit, it gives useful advice about how to get your ZX-81 up and running. The style is conversational — at times extrememly so. It includes over 50 programs covering a wide spectrum. If you are finding the manual that came with your ZX-81 a bit dull and difficult to follow then this is a good alternative way to get started.

Byteing Deeper Into Your ZX-81 by Mark Harrison is a pretty comprehensive book, packed with sound information and is an excellent book if you want to go further than the manual takes you. It starts off with two general chapters concerning 'The principles of a computer system' and the 'Formation of algorithms'. The other fourteen chapters are about using the ZX-81; 37 short programs are included and among them are some of the most interesting ones I have found. On the whole, the book is aimed at adult users, with a rather dry and dense style although it does include some games such as poker dice and prisoner's dilemma.

For Randle Hurley's **The Sinclair ZX-81 Programming for Real Applications** you'll need the 16K RAM pack. In his introductory chapter the author suggests that his book can be used at two levels, either as a source of 'off the peg' programs or as a guide to writing your own. I think it's more likely to be appreciated by the reader wanting the second approach as the programs are explained at every stage. If you simply want to use the programs you might consider investing in the comparison cassette which includes those described in the book. A word processing program, with optional readability calculator, is among those given. In this case the reader has the opportunity to judge the results since the chapter dealing with it has been printed using a simulation of the output that would be obtained from the ZX-81 printer. It demonstrates the limitations of only having a line width of 32 characters and rather confirms my view that, although for some applications the 16K ZX-81 is as powerful as computers five times its price (or more), handling text is not one of them! The final chapter of the book gives details of some hardware modifications that may be thought to improve the ZX-81. These include suggestions for an alternative lower voltage power supply and for a 'proper' keyboard.

Machine code programming is covered in **Understanding Your ZX-81 ROM**, a book although attempting to cover two quite different areas does not fulfil the task suggested by the title. Dr Logan's aim is to impart the ability to write short machine code programs so that the reader can produce programs of greater complexity. The first part of the book discusses the Z80 microprocessor and its instructions set — which is detailed in chapter four; chapter five presents 26 simple BASIC programs illustrating use of machine code instructions; chapter six examines the 8K monitor program (extracts from which are given throughout the book and also in Appendix 1) and includes the BASIC command routine addresses; and chapter seven goes through the process of producing machine code routines giving some well worked through examples. In spite of all the detailed explanation, however, I still came away with the impression that Dr Logan's book would not enable readers with only knowledge of BASIC to graduate to writing machine code. On the other hand, readers who already know how to program the Z80 will be disappointed not to find a complete listing of the monitor ROM in one place.

The books inlcuded in this month's selection were:

The Gateway Guide to the ZX-81 and ZX80 by Mark Charlton, published by Database Consultancy, distributed by Computer Bookshop (1981), 180 pages, £5.95.

Not only 30 Programs for the Sinclair ZX-81, published by Melbourne House, distributed by Computer Bookshop (1981), 104 pages, £6.95.

The ZX-81 Pocket Book by Trevor Toms, published by Phipps Associates (1981), 136 pages, £4.95.

The ZX-81 Companion by Bob Maunder, published by Linsac, 131 pages, £7.95.

Educare's 50, published by Educare,(1981),110pages, £4.95.

PEEK, POKE, BYTES and RAM! by Ian Stewart and Robin Jones, published by Shiva (1982), 109 pages, £4.95.

Byteing Deeper into Your ZX-81, by Mark Harrison, published by Sigma Technical Press, distributed by John Wiley (1981), £4.95.

The Sinclair ZX-81 Programming for Real Applications by Randle Hurley, published by Macmillan(1981),162pages,£6.95.

Understanding your ZX-81 ROM by Dr Ian Logan, published by Melbourne House (1981), 162 pages, £8.95.

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Peter Green

THE VALLEY

As promised last month we reveal the secrets of converting the program onto the TRS-80 system.

As a guide to program conversion techniques and as a showpiece highlighting some of the difficulties encountered fitting the game on a 64 x 16 screen, I began the frustrating task of converting The Valley for my TRS-80. I agree the TRS-80 has some excellent features but some stunningly bad ones as well.

The first major change that had to be made was the screen format but since none of the scenarios were more than 40 cells wide and 15 deep, they can be fitted, unaltered, on the right-hand side of the screen. However, the scenarios occupy most of the screen height leaving a space, 24 characters wide and 16 characters deep, on the left of the screen for status information and game messages; I cheated a little and re-wrote many of the messages to fit the shorter length line as shown below.

Unlike the PET which allows you fundamental changes were required to the original PET version to get the correct graphics on the TRS-80 screen. The most important change was to make sure whenever a 'row displacement' was calculated (for example, in line 2090 during the Movement routine and in the Black Tower module), the value for the row length was altered from 40 to 64.

Using the PET which allows you to start printing anywhere on the screen by programming the cursor control keys into PRINT statements directly from the keyboard, the TRS-80 cursor can only be moved using the clumsy PRINT CHR$ (control code) system.

The Tandy machine does, however, claim a few advantages over the PET. Not only does the TRS feature the PRINT @ statement, but it also supports the STRING$ statement allowing you to assign long strings of graphics characters in a single statement; economical in terms of bytes as well as typing effort.

Unfortunately a quirk of the Tandy PRINT statement meant that the re-writing had to be somewhat more extensive than first anticipated. On the TRS-80 a line feed automatically erases the whole of the next line. Consequently, while the game is in progress we cannot use line feeds to automatically place text on consecutive lines of the screen; if we do, large holes suddenly get hacked through the current scenario. All the messages and status updates that occur during the game must, therefore, have trailing semicolons to suppress the line feed. The text can still be positioned in the correct place by means of the PRINT @ statement.

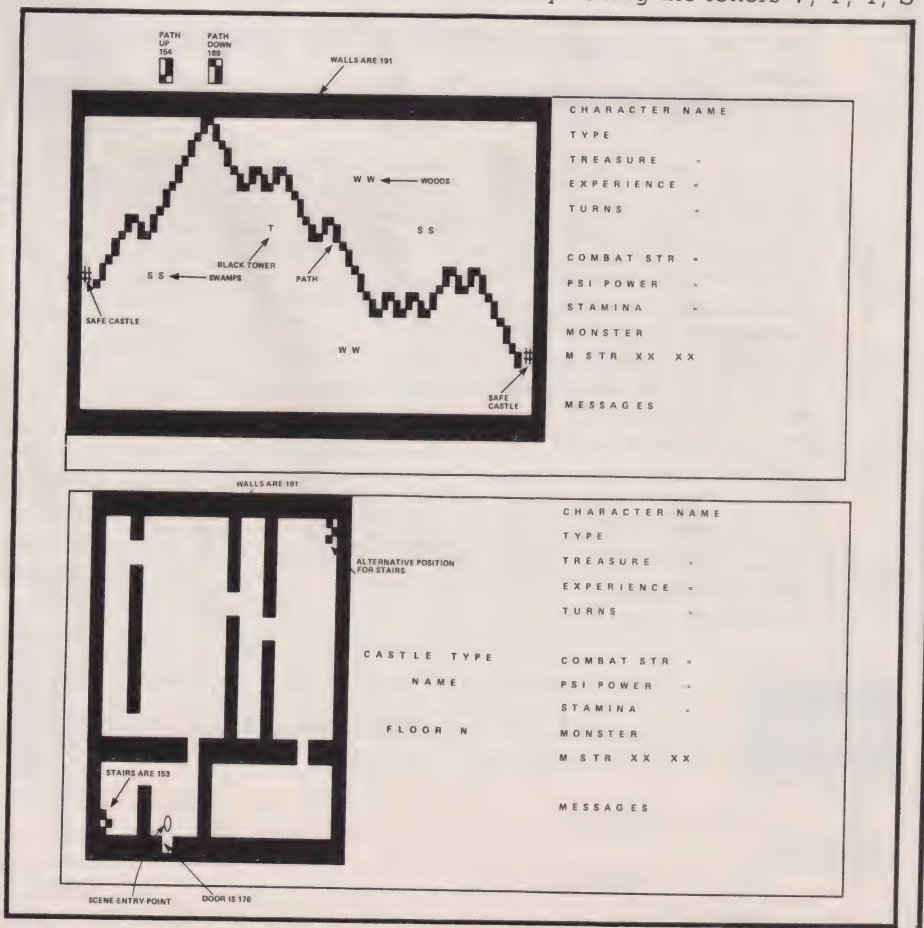
Text is printed starting on the 42nd column to allow a blank column between the text and the widest scenario. This means that the maximum line length is 23 characters so many of the existing one-line messages must be broken at suitable places in order to spread them over a number of lines.

Text is cleared from the screen area by PRINTing SP$, a string of 23 spaces, again suppressing the line feed. However, when the text is on the bottom line of the screen we have to use 22 spaces, LEFT$(SP$,22). If we don't take this precaution the screen will scroll even if a trailing semicolon is used thus destroying the scenario pattern.

Landscape Gardening

Drawing the Woods and Swamps on the PET requires a continuous section of Video RAM to be used and so only a single parameter is required to POKE the graphics characters (line 12060), the screen wrap-around does the rest. On the Tandy, however, these scenarios are only displayed on one side of the screen so a wrap-around would POKE vegetation all over the status display. You can get around this by changing line 12060 to a co-ordinate system by generating x and y co-ordinates and POKEing relative to the top left-hand corner of the scenario.

The next problem was deciding which characters to use to represent the various structures in the Valley. If you're only interested in text, the Tandy machine is one of the best around, but as for graphics ...! The upper case ASCII and 64 pixels offered by the TRS-80 are just not enough; I'm afraid my Valley looks pretty dull alongside the PET Valley. Using the letters V, Y, T, S



and W to represent Vounim's Lair, the Temple of Y'Nagioth, the Black Tower of Zaexon, the Swamps and the Woods respectively is not the most impressive sight I've witnessed but then you've got to work with what you've got.

The Safe Castle is made up of # (it looks like a portcullis) and trees were constructed from ↑ (a pine forest?). Since graphics code 191 was the only symbol that looked anything like walls or water, I was forced to use the same symbol for both and insert an extra test in the Movement routine so that you don't walk through walls or bounce off water! The final list of POKE codes chosen was given in Table 3 last month.

The next two changes made involved fundamental differences between PET BASIC and Tandy BASIC. First, the statement, 'GET GC$', in PET BASIC must be re-written 'GC$ = INKEY$' in Tandy BASIC. Second, the RND function must be randomised at the start of the program using the RANDOM statement and re-written slightly wherever it appears.

For a random number between 0 and 1, we use RND(0) instead of RND(TI) and for a random integer between 1 and n, RND(n) was used instead of RND(TI) *n+1. Thus, for example, line 3670 becomes RF=RND(10)−1 and line 9030 becomes N(I)=RND(5)+3.

I also used the useful IF ... THEN ... ELSE statement a couple of times in the conversion, but not too often as I wanted to keep the TRS-80 program similar in format to the original PET program — if only that it makes it easier to understand!

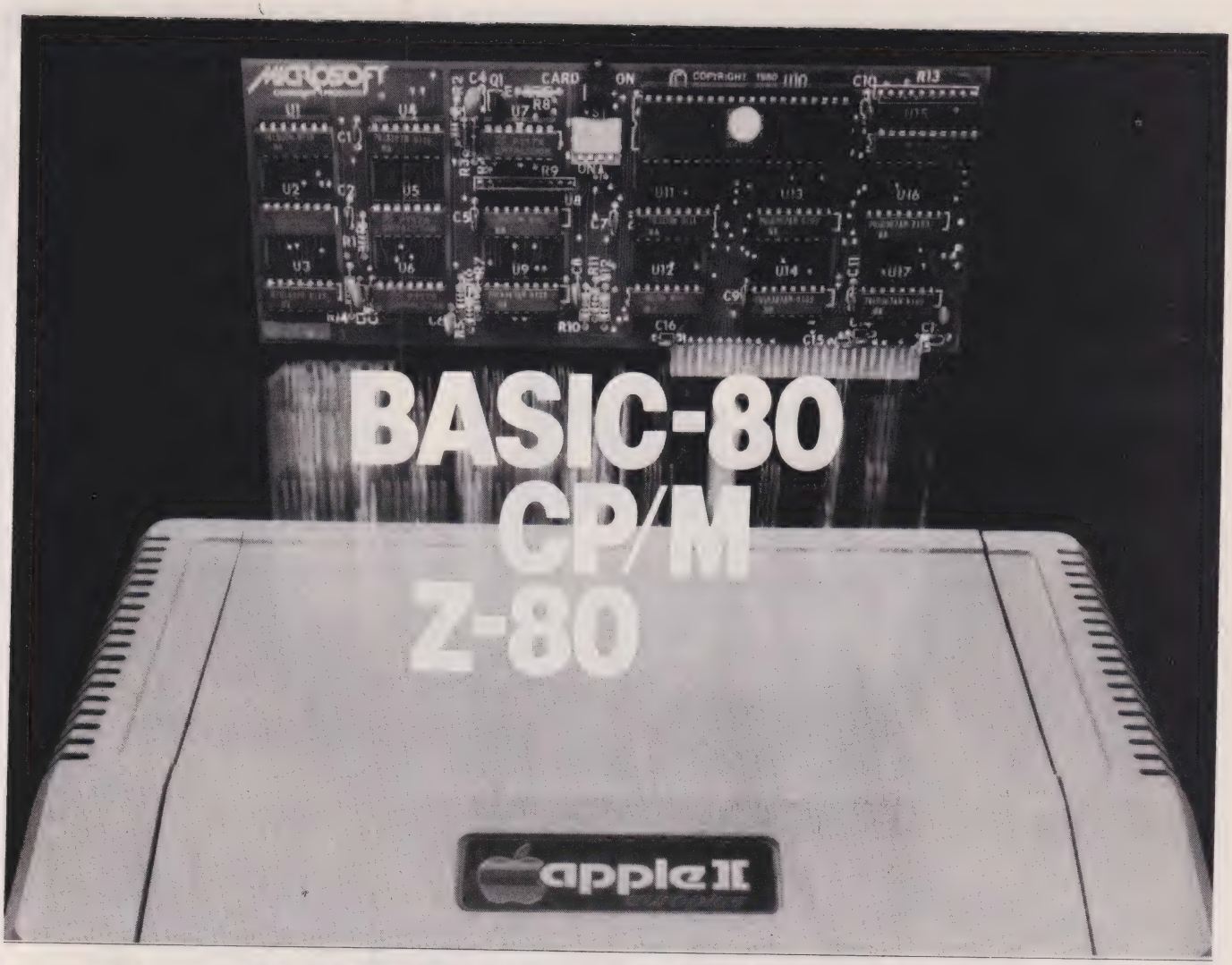
It appears that an extra PRINT statement has attached itself to the end of line 2890. This MUST be deleted or, under certain circumstances the castle scenario may scroll up the screen!

VG$	Valid characters for UNIGET routine
GC$	Character that has just been GOT
F$	Legal monster types, see Table 1
D$	Cursor Down string for positioning messages
D1$	Cursor Down string for positioning status
D2$	Cursor Down string for positioning lake
SP$	Space string for wiping away messages
R$	Cursor Right string, not used directly
R1$	Cursor Right string for positioning text
R2$	Cursor Right string for positioning lake
C$	Dummy string variable
J$	Character's name
P$	Character type
X$	Scene flag to compare against F$
M$	Monster type
DL$	Delay routine flag; "D" is delay only "W" is delay and wipe

D(3)	Width of rooms in castle-type scenes
G(73)	Path information. G(0) holds the game start position which is used in reincarnation
N(8)	Gives depth of rooms in castle-type scenarios. Elements 0 and 1 are not used
P(8)	Contains the starting point in DATA for each of the floors in castle-type scenes. Elements 0 and 1 are not used
S(4)	Scenario addresses in the Valley
T(2)	T(0) — Amulet T(1) — Stone count T(2) — Helm
M$(18)	Monster names
MS(18)	Monster strengths
N1(18)	Monster psionics

TN	Turns
TM	Timing factor — adjust for various systems
CF	Combat flag, 1 if fighting
I, J, K	General variables
G	Monster's damage to you
A	VAL of GC$

P1	Character's psionic gain factor
C1	Character's physical gain factor
CS	Character's combat strength
PS	Character's psionic strength
EX	Character's experience
TS	Character's treasure
C	Character's stamina
DF	Delay factor
DL	Delay loop counter
FL	'Floor' — actually determines the nastiness of the given scene as the bigger it is, the stronger the monsters
S	Scene number
M	Your current position
W	Where you are about to step
MP	Position held just before you entered a scene
MW	Position held just before you entered a scene within a scene (Vounim, etc)
PC	POKE character value used to build scenes
V	Dummy READ variable
N1 & N2	Random co-ordinates for scenarios, etc
PK	POKE value of object
Q	POKE value of what is on your current position
Q1	POKE value of what is in the position you just stepped on
RF & RN	Random numbers
MS	Monster's strength
N1	Monster's psionics
U	Experience gain factor
TV	Temporary flags
E	Experience factor
HF	Hit flag, 1 if the monster is 'defeated'
Z	Damage factor according to where you hit the monster or it hit you
D	Amount of damage done to the monster
TF	Temporary flag that prevents you leaving a scenario immediately
P	Step counter for scenario
L & L1	Index variables for scene building
SC	Spell control variable
H	Depth of walls on current floor of castle-type scene



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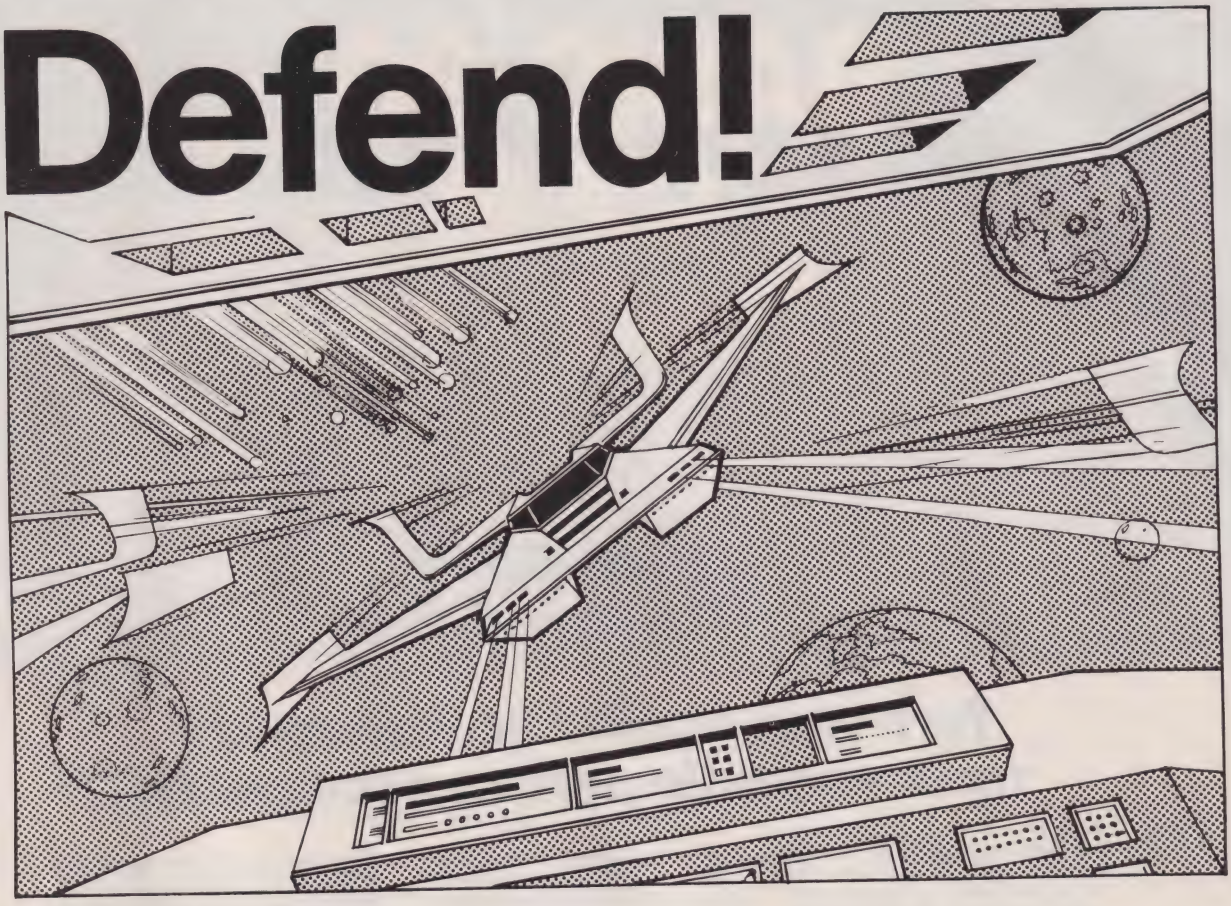

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Dear Sir,
I was absolutely incensed with anger and also sadness when I read 'Special Report 2' in the March issue of Computing Today, with the obvious advantages and benefits of the Microprofessor (MPF-1) either dismissed completely or just glossed over, and all the general inaccuracies and over-amplification of irrelevant facts contained therein. It was the manual that was reviewed in depth — not the MPF-1 hardware.

We sent the MPF-1 unit in mid-November 1981 at one of CT employees' specific request for an evaluation, which we were only too happy to oblige, even though at the time there were only two systems in Europe (we desperately needed both units). As a result I would like to point out the following:

1. We received no formal acknowledgement of its receipt and indeed, we have still not had it returned.
2. At no time was there any communication between the reviewer and this company. Standard product review protocol, even if it is just to find out you are in possession of the correct product!
3. We were never given a chance to explain any shortcomings in the pre-production model, which had no heatsink on the 7805 and was supplied with a 220 V European DIN mains adaptor. The reviewer spent a complete paragraph complaining about this yet a 30 second telephone call would have indicated all units are supplied with a 240 V adaptor, the 7805 has a heatsink and that from 1st March, 1982, all systems will have a 13A UK moulded plug adaptor. The paragraph is a waste of print.
4. We had no chance to explain the extras available, for instance:
(a) 2K Tiny BASIC interpreter EPROM (drops into 2K expansion socket). The reviewer spent another paragraph complaining, it is HEX only — wrong! More waste of print.
(b) Z80-PIO/Z80-CTC drop straight into sockets provided. PIO bus available.
(c) The EPROM programmer board (MPF/EPB) — PSU included, connects via ribbon cable to MPF-1, programs 2716/2732, etc. Price same as MPF-1.
(d) The speech synthesiser board (MPF/SCB) again connects via a ribbon cable to MPF-1. It uses TMS 5200/5220 and has an

expansion socket for the TMS6125. Price same as MPF-1.
(e) Four comprehensive manuals and advice on further reading.

The whole review was geared to knocking the MPF-1 while Special Report 1 in the same issue, surprise, surprise, was promoting the MENTA which, although it has a video output, is twice the price and only has half the memory and no room for expansion.

The MPF-1 can use, via the 24 pin DIL Header plug, the whole Z80A 64K facility! Not only 6K as the reviewer wrote.

The MPF-1, in short, is a Z80A microcomputer board with an immense scope for expansion. It is not sold as an autonomous training system and indeed, does not say so anywhere in the advertisement and the many educational establishments and industries that have bought the unit as an educational tool realise this and are creating their own courses around it. Although the reviewer did say if it had a properly structured course at a training establishment it would be usable. Well that is exactly what all the education establishments are doing. However, this was surrounded by so much bad criticism that you know the readers will hardly notice it.

As for actually making the recommendation and stating "...not to contemplate buying an MPR unless..." why not!! — it is the cheapest, most flexible Z80A evaluation system on the European market, and as for complaining its use of the Z80A as opposed to another MPU, words fail me!

Also, I would like to point out, that we have sold 500 units during January and February and only one has been returned for a hardware fault, which was replaced. Two were returned for refunds which were given the same day, because the manual was lacking. Therefore, it appears that 0.4% of our customers agree with your reviewer.

If you publish this letter our company will not view CT as such a biased journal, and will not have to spend another £5,000 on promoting its products.

The Multitech Corporation along with Flight Electronics Ltd. supply everything for microprocessor systems and we feel we are doing industry and especially the educational establishments, with their severely depleted budgets, a favour, by working on very small profit margins.

Wait until you see the price of the MPF-11 and what that can do!

Yours sincerely
Max D. Soffe
Managing Director
Flight Electronics Ltd.
Southampton

Dear Sir,
Thank you for giving me the opportunity to comment on the reaction of Flight Electronics' Mr M D Soffe to my review of the Multitech MicroProfessor (MPF). His main argument appears to be that I misrepresented the purpose of the MPF.

Mr Soffe states that 'The MPF-1... is not sold as an autonomous training system and indeed, does not say so anywhere in the advertisment...' The MPF advertisement in the March 1982 issue of CT contains phrases such as: '...solves the 'mystery' of microprocessors...', '...a microprocessor training tool for students, hobbyists and personnel.' 'The main object... is for the user to understand the software and hardware of a microcomputer easily and conveniently' and '...use the MICROPROFESSOR as a practical learning/teaching aid.' An advertisement which uses those terms in a leading hobby computing magazine is, in my opinion, unmistakably one for a training system. If I bought the package on the strength of the ad, I would expect to be able to use it to learn about micros with no extra back-up.

Since the MPF is presented as a training system, it is essential to pay special attention to its documentation — a vital element of the package. With that in mind, I consider that 20 column-inches in

a 55 column-inch article is a reasonable amount of space to devote to the manual.

I take offence at the suggestion that I did not present the MPF as I should have. A reviewer must describe the system he is given, not approach the supplier in order to find out what he should say.

If I may now comment on Mr Soffe's specific complaints:
a. 'There was no communication between reviewer and company'. Correct — I did not contact Flight Electronics, and saw no need to.
b. 'Flight did not have an opportunity to explain shortcomings in the pre-production model'. Surely, if a supplier is forced to offer a pre-production item for review, the onus is upon him to identify any known shortcomings which will be corrected in production. If he fails to take this obvious step, he cannot object to the reviewer criticising the weaknesses. Had the company indicated that the review item had a non-standard power supply, then I would not, of course, have complained about it.
c. 'Flight had no chance to describe the extras available.' Why should they? I was reviewing the basic system. Some of the extras, such as the tiny BASIC, are not even advertised yet! Incidentally, the system most certainly is Hex-based. The addition of BASIC would change this, but would also require a full keyboard, video monitor and suitable interface circuits, none of which come cheaply.
d. 'The MPF can address 64K via the . . .header plug.' No doubt it can, but the manual does not explain anything about this connector and quite clearly states that the maximum RAM is 6K.
e. 'The system is intended as an educational tool.' As I pointed out above, I think the advertisement is misleading on this point although my review agreed that the MPF could be of use in a properly-designed course.
f. Mr Soffe objects to my advising people not to consider buying an MPF. In fact, the review says: '(do not) contemplate buying an MPF unless you particularly want a cheap, but nicely made, single-board computer with an effective Hex monitor.' I fail to see how he can possibly object to those sentiments if he considers the MPF to be primarily a Z80 evaluation system.
g. Use of the Z80. I am convinced that the Z80 is a bad choice for a training system. It is the most complex of the common eight-bit micros having 22 user-accessible registers and 158 basic instruction types. That is far too intimidating for a beginner for whom something like the 6502 with its eight registers and 55 instruction types would be a better introduction.

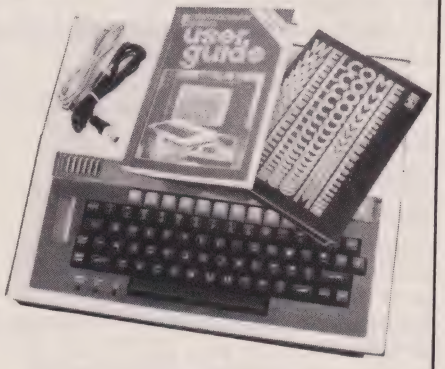
In conclusion, I cannot accept that I was unnecessarily subjective in my review of the MicroProfessor. Indeed, by openly declaring my fundamental objections to any training aid of this kind, I hoped to establish that I was assessing the equipment honestly in spite of my opinions.

Yours sincerely
D S Peckett
Dyfed

Dear Sir,
Adventure games are great fun — up to a point. That point is when you've tried everything you can think of and nothing seems to work. For such a creative way of using a micro this seems a limitation, particularly when, like me, you are trying to use the game as an educational activity.

I'd like to develop the game in a more open-ended way for use with school students in English and I would be delighted to hear from anyone who may have some ideas as to how I might set about doing so.

Rumours abound regarding the overheating of the power-supply in the BBC Micro. Your User Report in the March issue alluded to the problem once again.



I would like to anticipate any difficulties by obtaining a suitable fan. I know they exist for some other machines; is there one available which could be used with the BBC micro?

Yours faithfully
Daniel Chandler
Milton Keynes

(* I must say that I tend to agree with your sentiments about the illogicallity of some of the Adventure-type games available. If any of our readers have views on this subject we'd be delighted to hear them so either write to us and we'll forward the letters or contact Mr Chandler direct. With regard to your point about the BBC power supply — worry not, they are being replaced with switch mode supplies that are cool, man, cool! Ed. *)

Dear Sir,
I would like to take the opportunity to comment on the letter in the February issue with reference to the Tandy VII Printer. I think the form feed code must also depend on the particular model of computer being used since on my TRS 80 Model III,

LPRINT CHR$(11)

produces a single line feed. For a form feed the code is:-

LPRINT CHR$(12)

Yours faithfully
P Bolton
Beckenham

Dear Sir,
I wish to inform you that, as of today, I have taken over the job of Secretary for the Leeds Microcomputer User's Group. Our previous Secretary, Paul O'Higgins, has reluctantly had to give up the post due to pressures of study.

The User Group started out as a NASCOM club but we have branched out and all are welcome. Our present membership includes ZX80/81 owners, Apple and, of course, NASCOM owners.

We meet fortnightly on a Thursday night at British Telecom House (beside the Olympic Pool) in Leeds.

Anybody who is interested in our Group should contact me at the address below.

Yours faithfully
Ian J Clemmett
27 Brudenell MT
Headingley
Leeds LS6

Dear Sir,
Thank you for giving me the opportunity to clarify the situation regarding the BBC Micro and the special printer Epson are supposed to be producing for it.

When the requirement for a low cost printer able to print High Resolution Graphics arose the Epson MX70 was considered ideal. It is a dot matrix 80 CPS unidirectional printer with 9-pin dot head, 5x7 character font and a graphics capability of 480x8 dots per line. This has been under evaluation for some time, and in the meantime Epson have introduced a new graphics printer, the MX80 type II — available in a tractor or friction/tractor version.

The MX80 Type II has numerous advantages over its predecessor including a variety of printing sizes, ie condensed, enlarged, emphasized, etc. It is also bi-directional. A 9-pin dot head gives true descenders and it is dot addressable: in the normal mode, 480x8, or in dual density, 960x8 dots per line. It also offers international character set which is software selectable.

I would like to advise people buying the BBC Micro not to wait for the MX70, which we have stopped marketing, but to go for the MX80 Type II offering extra functions. Unfortunately in the past, graphics printers were associated with high cost but to get the message across, Epson have decided that from the 1st March to 31st April the MX80 F/T Type II will be offered at a special price. The purpose is to give customers an opportunity to buy a graphics printer at a similar price to a text printer.

I hope that my letter clears up some of the mystery associated with a 'Special Printer' but if anyone still wants to purchase the MX70, they are welcome to get one from Epson America who still have a few in stock.

Yours sincerely
T Shah
Sales Engineer
Epson (UK) Ltd.
Wembley

Dear Sir,
Anyone in the South Wales area interested in computing should contact Gwent Amateur Computer Club Secretary, Ian Hazell, at 50 Ringwood Hill, Newport, Gwent NPT 9EB (SAE appreciated).

Alternatively, telephone (in the evening) Rotheray Ham on Newport 852 924.

Meetings are currently at St Mary's Church Hall, Stow Hill, Newport on Thursdays from 8pm.

Thank you for your co-operation.

Yours sincerely
Ian Hazell
Newport

Dear Sir,
Many people have complained about Sinclair Research Limited not replying to their letters. I, too, had problems getting through when I wrote to Dept. FM (repairs). I have since then got the problems with my ZX81 sorted out and wish to report that Sinclair Research Limited were very understanding. I was informed that Dept. FM does not handle correspondence. Hence I suggest that people whose ZX81s are faulty should write to the Sales Manager, Sinclair Research Limited, 6 King's Parade, Cambridge CB2 1SN.

Yours faithfully
S M Parmar
Leicester

Dear Sir,
Having read the anonymous Sorcerer's Graphics article in February's issue of Computing Today with great interest, I felt I must make the following comments:

1. In reply to the question 'Did somebody pick the wrong signal?', my answer would be 'No'.

Between the execution of each statement, Exidy BASIC calls a routine called QUICK CHECK which scans the keyboard for ESC, CTRL C and RUN/STOP. This routine in turn calls the routine GET IY at E1A2. If GET IY was to wait for the vertical blanking period instead of the horizontal blanking period, then the execution of BASIC could be delayed as the routine could have to wait a maximum of 15.3 mS before a blanking period occurs instead of 40.5 uS.

2. Notice in the above that I have referred to 'blanking' — not 'flyback' periods. The signal used (E256) is in fact the output of a bistable which sets eight counts (6.319 MHz pulses) before the start of horizontal blanking and resets seven counts before the end of horizontal blanking.

The GET IY routine checks this signal then waits for a count of approximately 438 (69.3 uS) which should be the next blanking period before accessing the pivot address F000/1. Screen flicker is caused when the GET IY routine samples near the end of horizontal blanking and the count then takes it up to approximately 4.4 uS (seven character periods) into the next but one display period. This causes a black line to appear on the screen lasting five or six (usually six) character periods.

It is possible to overcome this by a re-write of the GET IY routine but the new routine requires more ROM space and could only be included in a new monitor.

3. The counts quoted in the article for the line scan counter are incorrect and should be 255 and 148, the counter being preset to 1 and 108 respectively. The horizontal sync (flyback) pulse occurs between the 52nd and 84th counts of the 148 count phase.

Characters are read in two stages — first a byte is read from the screen RAM to a latch where it becomes the address for the character generators and second, the output of the character generator is fed to the video shift register.

Yours faithfully
R I French
Hassocks

(* For reasons unknown, the author's name appears to have vanished from its correct position on the page — it was in fact Don Thomasson. Our apologies to him and our thanks to you for a most interesting letter. Ed. *)

Dear Sir,
I note with interest an advertisement in your January issue for a Wood Processing package for the BBC Micro.

I presume that it will handle logs and branches!

Yours faithfully
J W Bainbridge
Wrexham

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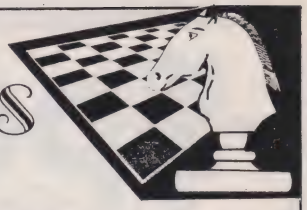

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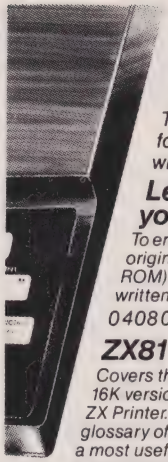

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